

Contents

CHEMWATCH

(click on page numbers for links)

REGULATORY UPDATE

ASIA PACIFIC

Workplace exposure standards open for public comment – Release 2: Acetaldehyde to benzoyl chloride.....	4
Amendment of chemical name	4
Approved Active Constituents	5
Submissions open on chemical review	5
Taiwan Publishes FAQs for Chemical Registration.....	6
China MIIT Cancels 33 Documents for Market Access Management of Raw Material Industry.....	7

AMERICA

EPA proposes updates to air regulations for oil and gas to remove redundant requirements and reduce burden.....	8
EPA Announces Revision To Current Pesticide Crop Grouping Regulations.....	11
Without federal guidelines, Washington is creating its own standard for testing weed.....	11
Long paper receipts can stay for now, as California lawmakers reject ban	13
EPA's 20 Proposed Low-Priority and High-Priority Chemical Substances: Comments are Due November 2019.....	15

EUROPE

Relabelling obligations under the CLP Regulation (Regulation (EC) No. 1272/2008) in relation to Methylisothiazolinone (MIT)	19
EC Requests Scientific Opinion on Three Coatings for Nano Forms of Zinc Oxide as a UV Filter in Dermal Applied Cosmetic Products	20
Germany AwSV List of published WGK classifications updated	21

REACH UPDATE

New proposal to harmonise classification and labelling	22
Public consultations on harmonised classification and labelling.....	22
Take a look at our interactive table of elements	22
Four proposals to identify substances of very high concern (SVHCs).....	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

Substance evaluation conclusions published23

JANET'S CORNER

Environmental Impact Statement.....25

HAZARD ALERT

Mercury.....26

GOSSIP

Making microbes that transform greenhouse gases.....32

Rubik's cube with a chemical twist.....33

How buildings can cut 80% of their carbon emissions by 205034

Why are people still dying of malaria when we have a treatment?36

Inside China's attempt to boost crop yields with electric fields39

Stealth glider made out of special polymer self-destructs in sunlight.....43

NASA Images Show Just How Much Carbon Monoxide Is Coming
Off The Burning Amazon44

Physicists Find Evidence of Superconductivity at Temperatures Well
Above The Current Threshold45

Mosquito incognito: Could graphene-lined clothing help prevent
mosquito bites?46

A new way to make valuable chemicals48

Chemists discover water microdroplets spontaneously produce
hydrogen peroxide49

Tiny tweaks for big wins in solar cells51

New coating brings lithium metal battery closer to reality52

3-D printed salt template for bioresorbable bone implants53

Can't get thinner than this: Synthesis of atomically flat boron sheets.....55

New rechargeable aqueous battery challenges Lithium-ion dominance..56

Producing protein batteries for safer, environmentally friendly
power storage57

CURIOSITIES

Genetic studies suggest alcohol isn't linked to breast cancer after all59

Have we found the true cause of diabetes, stroke and Alzheimer's?60

Contents

CHEMWATCH

A Major Cyber Attack Could Be Just as Deadly as Nuclear Weapons, Says Scientist.....	66
You Could Be “Smoking” a Pack of Cigarettes a Day Just by Breathing in City Air	69
We ‘eat a credit-card worth of plastic’ a week. Do water filters help?.....	70
Israeli Researchers Are Using 3D Printing Technology To Help Rebuild Coral Reefs.....	71
Emails Show Monsanto Orchestrated GOP Effort To Intimidate Cancer Researchers.....	73
Workers at Big Government Lab Sue Over Exposure to a Toxic Chemical..	77
Retail giants face pressure to change chemical-coated receipt paper	80
Toxic chemicals can enter food through packaging, so we made a list	82

TECHNICAL NOTES

(Note: Open your Web Browser and click on Heading to link to section)...	85
ENVIRONMENTAL RESEARCH	85
MEDICAL RESEARCH.....	85
OCCUPATIONAL RESEARCH	85
PUBLIC HEALTH RESEARCH.....	86

ASIA PACIFIC

Workplace exposure standards open for public comment – Release 2: Acetaldehyde to benzoyl chloride

2019-09-06

Safe Work Australia is evaluating the Workplace exposure standards for airborne contaminants to ensure they are based on the highest quality evidence and supported by a rigorous scientific approach. Release 2: Acetaldehyde to benzoyl chloride is now open for public comment. This includes new chemicals o-anisidine, benzidine, 1H-benzotriazole and benzoyl chloride. In particular, the agency is seeking comments of a technical nature regarding:

- the toxicological information and data that the value is based upon, and
- the measurement and analysis information provided.

Access our consultation platform, Engage to provide your comments on the draft evaluation reports and recommendations for Release 2. Public comment will close on 27 September 2019. The feedback received will be considered when making final recommendations for workplace exposure standards. The draft evaluation reports and recommendations for the remaining chemicals will be released throughout 2019 and 2020. If you know someone who has an interest in workplace exposure standards, please forward this email and recommend they subscribe to the 'chemicals exposure standards' mailing list to stay informed about the review and release dates. Further information is available at the Safe Work Australia website.

Safe Work Australia, 2 September 2019

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

Amendment of chemical name

2019-09-06

The National Industrial Chemicals Notification and Assessment Scheme (NICNAS) have updated the name of the following chemical in the Australian Inventory of Chemical Substances (the Inventory) to the Chemical Abstracts Service (CAS) name. The previous chemical name has been added as an associated name in the chemical record. This update does not change the identity of the chemical concerned. This amendment

Safe Work Australia are calling for comments on the recommendations for Release 2: Acetaldehyde to benzoyl chloride.

Regulatory Update

CHEMWATCH

is in accordance with section 20(b) of the Industrial Chemicals (Notification and Assessment) Act 1989.

<i>Amendment of chemical name</i>		
Previous chemical name	Amended chemical name	CAS number
Waxes and waxy substances, jojoba	Jojoba oil	61789-91-1

NICNAS Chemical Gazette, 3 September 2019

http://www.nicnas.gov.au/Publications/Chemical_Gazette

Approved Active Constituents

2019-09-06

The Australian Pesticides and Veterinary Medicines Authority (APVMA) has published a notice that it has approved or varied the relevant particulars or conditions of the approval of the following active constituents, with effect from the dates shown.

1. ACTIVE CONSTITUENT

Application no.: 118709

Active constituent/s: fipronil

Applicant name: Jiangsu Yunfan Chemical Co Ltd

Applicant ACN: N/A

Summary of use: For use in agricultural and veterinary chemical products

Date of approval: 15 August 2019

Approval no.: 87583

APVMA Chemical Gazette, 27 August 2019

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

Submissions open on chemical review

2019-09-06

New Zealand Environmental Protection Authority (EPA) are seeking submissions on a proposed review of the hazard classifications of a range

New Zealand Environmental Protection Authority (EPA) are seeking submissions on a proposed review of the hazard classifications of a range of substances.

Regulatory Update

CHEMWATCH

of substances. The EPA regulates pesticides, household chemicals and other dangerous goods and substances under the Hazardous Substances and New Organisms Act. As well as evaluating and approving substances, we can reassess substances and make new decisions about whether the hazard classifications and controls (rules around their use) need to be updated. EPA are proposing to update the hazard classifications of 79 substances – including single chemicals, and mixtures containing chemicals – to take into account new information such as study data, and reviews or assessments by overseas chemical regulators. The hazardous properties of a substance are classified to determine how, when considered in combination with the likely exposure to the substance, the risks can be managed. Changes to hazard classifications may result in changes to the controls that apply to the substances. The substances covered in the review include iodocarb (a fungicide and antimicrobial used in paints, agrichemicals, and timber treatment products) and sulfur (uses include as a component in fertilisers; in animal care and nutritional products). This application is being processed as a modified reassessment, which means that only specific aspects of the approvals will be considered during the reassessment, and the approvals cannot be revoked (i.e. substances cannot be banned) in this process. Suppliers, manufacturers and users of chemical products should check the application documents to see whether their products are affected by the proposed changes. This chemical review is part of our chemical reassessments program. This program includes a Priority Chemicals List of 39 chemicals we believe are most in need of review in New Zealand. The agency is reviewing chemicals on this list. More than 700 chemicals were screened during the development of the PCL, and we continue to screen chemicals when new information becomes available. Submissions on the chemical review close Wednesday 25 September 2019. Further information is available at:

[Details about the application, including the full list of substances included and submission forms.](#)

N.Z EPA, 29 August 2019

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

Taiwan Publishes FAQs for Chemical Registration

2019-09-06

On 28 August 2019, Taiwan issued a [FAQ document](#) containing 420 frequently-asked questions collected from nine industry focused seminars held from March to May this year addressing issues relating to the revised

**On 28 August 2019,
Taiwan published
420 FAQs on its
New and Existing
Chemical Registra-
tion Regulation.**

Regulatory Update

CHEMWATCH

New and Existing Chemical Registration Regulation (English version). The amendments of the Regulation were promulgated on 11 March 2019. The standard registration of 106 priority existing chemical substances at or above one tonne a year is required from 1 January 2020 if companies wish to continue manufacturing/importing them. In addition, annual reporting of the registered new and existing substances is mandatory from 2020. Relevant companies may not be ready and need guidance on what to do for the associated registration and reporting obligations. To relieve the industry' anxiety, the authority has held several seminars for policy dissemination, as well as providing important dialogue with the industry. The seminar materials can be accessed [here](#). However, the most important Guidance for Standard Registration is still a draft version and waits further development. Currently the FAQs document is only available in traditional Chinese. It provides answers to the following aspects:

- Regulatory mechanism: 90 questions
- Registration operation (including the submission system, change/ repeal registration, etc.): 124 questions
- Registration number (in place of the registration document): 2 questions
- Joint registration and SIEF-like platform: 34 questions
- Standard registration and supporting measures of designated priority existing chemical substances: 89 questions
- Annual reporting: 59 questions
- Others (including cross-ministerial cooperation): 22 questions

The authority will keep updating the FAQ document upon receiving additional questions from seminars.

Chemlinked, 28 August 2019

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

China MIIT Cancels 33 Documents for Market Access Management of Raw Material Industry

2019-09-06

On 14 August 2019, the Chinese Ministry of Industry and Information Technology (MIIT) issued a notice, announcing the abolition of 33 documents for market access management of the raw material industry. The removed documents are related to 11 raw material sectors, including yellow phosphorus, foundry pig iron, ferroalloy, hydrogen fluoride, etc. They are either regulations laying out requirements for enterprises in

China MIIT announced that 33 documents for market access management of the raw material industry would be abolished starting from 14 August 2019

Regulatory Update

CHEMWATCH

terms of location, technical processes, equipment, product quality, energy consumption and environmental protection, etc. or lists of qualified businesses. The notice briefly points out that these regulations and market access rules are lifted to follow the requirements of the central government on “pushing forward with reforms that delegate power, improve regulation and upgrade services”. The reforms, firstly proposed in 2015, are essentially aimed at promoting transformation of government functions and ensuring that market can play a determining role in resources allocation. It is believed that, with these regulations removed, China can open up wider access to the raw material industry, encourage inflow of funds into relevant sectors, and thus further invigorate the economy. Moreover, the notice also specifies that relevant industry bodies are encouraged to, in place of governments, enhance industry self-regulation and safeguard the market order. Nevertheless, relevant industry bodies, such as the China Nonferrous Metals Industry Association, have not issued any requirement or restriction on enterprises’ market access. It remains uncertain what measures will be taken during the transition period, and doubts have arisen in the industry. Further information is available at: [MIIT Notice](#)

Chemlinked, 28 August 2019

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

AMERICA

EPA proposes updates to air regulations for oil and gas to remove redundant requirements and reduce burden

2019-09-06

The United States Environmental Protection Agency (EPA) proposed updates to the prior administration’s national standards for the oil and natural gas industry. The proposal would remove regulatory duplication and save the industry millions of dollars in compliance costs each year – while maintaining health and environmental regulations on oil and gas sources that the agency considers appropriate. This proposal is the result of EPA’s review of the 2016 New Source Performance Standards (NSPS) for the oil and natural gas industry, which was conducted in response to President Trump’s Executive Order 13783 - Promoting Energy Independence and Economic Growth. That order directs agencies to review existing regulations that potentially “burden the development or use of domestically produced energy resources,” including oil and

The United States Environmental Protection Agency (EPA) proposed updates to the prior administration’s national standards for the oil and natural gas industry.

Regulatory Update

CHEMWATCH

natural gas. EPA's regulatory impact analysis estimates that the proposed amendments would save the oil and natural gas industry \$17-\$19 million a year, for a total of \$97-\$123 million from 2019 through 2025. The U.S. Environmental Protection Agency (EPA) proposed updates to the prior administration's national standards for the oil and natural gas industry. The proposal would remove regulatory duplication and save the industry millions of dollars in compliance costs each year – while maintaining health and environmental regulations on oil and gas sources that the agency considers appropriate. The proposal is the result of EPA's review of the 2016 New Source Performance Standards (NSPS) for the oil and natural gas industry, which was conducted in response to President Trump's Executive Order 13783 - Promoting Energy Independence and Economic Growth. That order directs agencies to review existing regulations that potentially "burden the development or use of domestically produced energy resources," including oil and natural gas. EPA's regulatory impact analysis estimates that the proposed amendments would save the oil and natural gas industry \$17-\$19 million a year, for a total of \$97-\$123 million from 2019 through 2025.

"EPA's proposal delivers on President Trump's executive order and removes unnecessary and duplicative regulatory burdens from the oil and gas industry," said EPA Administrator Andrew Wheeler. "The Trump Administration recognizes that methane is valuable, and the industry has an incentive to minimize leaks and maximize its use. Since 1990, natural gas production in the United States has almost doubled while methane emissions across the natural gas industry have fallen by nearly 15%. Our regulations should not stifle this innovation and progress." "EPA is committed to reforming duplicative requirements that impose costs on industry," said EPA Regional Administrator Gregory Sopkin. "Our state partners and producers in EPA Region 8 have made substantial investments in reducing air emissions from oil and gas operations, and they will continue to do so without the burden of unnecessary federal mandates." "I'm glad to see the EPA move forward with these critical, common sense reforms that reduce burdensome regulations on the oil and gas industry, which in turn is a huge win for Colorado. I look forward to seeing the industry continue the good work they're doing to reduce methane emissions while maximizing its safe production and use without the heavy hand of the government forcing them to do so," said Congressman Ken Buck (R-CO). "I applaud Administrator Wheeler for correcting the Obama Administration's improper regulatory overreach and for following the letter of the law. Today's proposed rule will remove duplicative and unnecessary regulations which needlessly burden the

Regulatory Update

CHEMWATCH

development and use of our domestic energy resources. The fact is that the oil and gas industry will always have an economic incentive to limit methane because capturing it allows companies to sell more gas. That is why methane emissions have continued to decrease while energy production has increased over the same time period. Innovation and technology improvements within the oil and gas industry and not ideologically driven government regulation has made the U.S. the world's leader in emissions reductions," said Congressman Doug Lamborn (R-CO).

EPA is co-proposing two actions, both of which would remove unnecessary regulatory duplication in the 2016 rule. In its primary proposal, the agency would remove sources in the transmission and storage segment of the oil and gas industry from regulation. These sources include transmission compressor stations, pneumatic controllers, and underground storage vessels. The agency is proposing that the addition of these sources to the 2016 rule was not appropriate, noting that the agency did not make a separate finding to determine that the emissions from the transmission and storage segment of the industry causes or significantly contributes to air pollution that may endanger public health or welfare. The primary proposal also would rescind emissions limits for methane, from the production and processing segments of the industry but would keep emissions limits for ozone-forming volatile organic compounds (VOCs). These sources include well completions, pneumatic pumps, pneumatic controllers, gathering and boosting compressors, natural gas processing plants and storage tanks. The controls to reduce VOCs emissions also reduce methane at the same time, so separate methane limitations for that segment of the industry are redundant. In an alternative proposal, EPA would rescind the methane emissions limitations without removing from regulation any sources from the transmission and storage segment of the industry. The agency also is seeking comment on alternative interpretations of EPA's legal authority to regulate pollutants under section 111(b)(1)(A) of the Clean Air Act. This proposal is in addition to a September 2018 technical action that proposed targeted improvements to help streamline implementation, reduce duplication of EPA and state requirements, and significantly decrease unnecessary burdens on domestic energy producers. EPA is currently reviewing comments received on that technical package and expects to issue a final rule in the upcoming months. EPA will take comment on the proposal for 60 days after it is published in the Federal Register and will hold a public hearing. Details of the hearing will be announced shortly. More information, including a pre-publication version of the Federal Register

Regulatory Update

CHEMWATCH

notice and a fact sheet, is available at: <https://www.epa.gov/controlling-air-pollution-oil-and-natural-gas-industry>

U.S EPA, 29 August 2019

<http://www.epa.gov>

EPA Announces Revision To Current Pesticide Crop Grouping Regulations

2019-09-06

On 27 August 2019, the U.S. Environmental Protection Agency (EPA) announced via the Federal Register, proposed revisions to its pesticide tolerance crop grouping regulations. These regulations allow the establishment of tolerances for multiple related crops based on data from a representative set of crops. EPA is proposing the revision of one commodity definition and the addition of three new commodity definitions. In addition, EPA's proposal includes an amendment to the herbs and spices crop group currently provided in Crop Group 19. The crops in current Crop Group 19: Herbs and Spices Group will be separated into two new crop groups: Crop Group 25: Herb Group and Crop Group 26: Spice Group. These revisions aim to increase the utility and benefit of the crop grouping system for producers and other commercial agriculture stakeholders. Over the next several years, a series of crop group updates is expected. Comments are due on October 28, 2019.

National Law Review, 30 August 2019

<http://www.natlawreview.com>

Without federal guidelines, Washington is creating its own standard for testing weed

2019-09-06

A year before Washington legalised recreational cannabis use in 2014, Nick Mosely co-founded Confidence Analytics. It was the second accredited lab in the state for testing marijuana products, and the first to test a sample meant for market. Typically, labs like Mosely's test cannabis to ensure that it's free of contaminants and safe to sell. They also determine potency of key components like THC for accurate labelling. But Mosely says one problem plagued the lab from the beginning: Cannabis is federally illegal, so labs in Washington had no established guidelines for testing cannabis. Usually, states base guidelines off of pre-established ones created by the federal government. Washington created standards

Regulatory Update

CHEMWATCH

to safely test drinking water by basing them on Environmental Protection Agency standards, for example. Without federal support, the dozen labs like Redmond-based Confidence Analytics were forced to create their own standards. "Basically, each lab has to individually develop and validate their own method for each of the tests they're responsible for," he says. "They've done this independently, largely in a vacuum, without a lot of coordinated communication between them." Mosely says that figuring out these standards is "challenging and expensive"; the extra effort required and lack of oversight can also leave space for less diligent labs to cut corners. Mosely offers an example: Theoretically, the perception that higher amounts of THC might be more attractive to customers could lead a lab to fudge results — and without established governmental standards, there would be few ways for customers to know or industry to correct the problem. "The information that the labs provide has a profound impact on the quality and price of the product," he says. "There's incentive for — there's no better word for it — cheating." But this year, the Washington state Legislature took steps toward remedying that by passing a [bill](#) that will build a standard for cannabis lab accreditation. The ability to accredit will be transferred by 2024 from the Liquor and Cannabis Board to the Department of Ecology, which will eventually create a state-wide standard. To that end, the bill requires that the DOE convene a [cannabis science task force](#) to begin working on formulating these guidelines, with the first report due from team to Legislature by June 2020. Jessica Archer, the task force's state-wide coordination manager, says accreditation is basically "making sure that cannabis labs are following appropriate methods to get accurate results." "Lab accreditation is an important piece in the puzzle in making sure that when folks go out and purchase this product ... they're purchasing what it says they're purchasing on the product label," she says. Kendra Hodgson, the liquor board's cannabis examiner manager, says it's an important step forward, especially because agencies like the DOE are better equipped with the scientific resources to monitor laboratory procedures. Typically, Hodgson says, states base their guidelines off of federal standards, as they do when checking the quality of other consumables, like water. But because cannabis isn't legal federally, there isn't a framework on which to base lab-testing standards. "The landscape of no federal regulation on this is really unique," Hodgson says. "All the other states [with legal marijuana] are in that same bucket." When cannabis was first legalised in Washington, Hodgson says the Liquor and Cannabis Board was the only agency specifically called out in the bill's text for managing oversight for the new industry. Other regulatory agencies better positioned to conduct lab testing "were reluctant to touch it" without federal legalisation. As a result, the board was tasked with a host

Regulatory Update

CHEMWATCH

of responsibilities for the marijuana market, including overseeing who tested the cannabis products and what they tested for. "We were breaking new ground as we did this," she says. Now, Hodgson says that "many of these agencies have come around appropriately," and bills like this most recent one allowing the board to redistribute some of the responsibilities it initially was saddled with. Other states have grappled with this issue in their own ways. Sarah Sekerak, the task force's lead chemist, says Colorado initially tasked its commerce department with lab accreditation duties after state-wide legalisation. But as that department had little knowledge about accreditation or cannabis labs within its network, it moved some of those responsibilities to the state Department of Public Health and Environment. "I think a lot of the states [are] in the same arena," Sekerak says. "Unfortunately, that structure is kind of a patchwork of what we're developing. We're all kind of unique in our state structure and our oversight." Confidence Analytics' Mosely says the Legislature's bill is a step forward, but there's still more to be desired: "There's a lot of frustration in the cannabis community," he says. While the bill allows DOE to determine how and which labs test cannabis products, the responsibility for what exactly is tested is still under the Liquor and Cannabis Board's purview. Mosely says he hopes that this and proposals like "Cannabis 2.0," which seek to envision and plan for the next few years of the legal marijuana market, will bring more oversight to cannabis-testing labs in Washington. "We've been struggling with this since day one," he says. Most lab owners he's talked to have echoed his concerns, and at the end of the day, Mosely says simply: "The majority of labs you'd [talk to], you'd get a similar reaction. Most people want to do the right thing."

Crosscut, 2 September 2019

<https://crosscut.com>

Long paper receipts can stay for now, as California lawmakers reject ban

2019-09-06

Props, costumes and a Jimmy Kimmel joke weren't enough to prevent the California Senate from trashing a bill that would have restricted retailers from routinely handing out unwanted and unusually long receipts. Assembly Bill 161 by Assemblyman Phil Ting (D-San Francisco) would have required stores to ask consumers if they wanted receipts before printing them in an effort to reduce paper waste in the state. The bill had been significantly scaled back in recent months after criticism from the paper industry and business groups. Finally, it stalled in the

Props, costumes and a Jimmy Kimmel joke weren't enough to prevent the California Senate from trashing a bill that would have restricted retailers from routinely handing out unwanted and unusually long receipts.

Regulatory Update

CHEMWATCH

Senate Appropriations Committee. "We are very disappointed," Ting said, adding that he will probably try again next year. "We think this bill made a lot of sense and had clear environmental impacts." The bill initially would have required businesses by 2022 to provide customers electronic receipts unless a paper printout was requested. Provisions calling for digital receipts prompted privacy concerns and were ultimately dropped. The version of the bill that was sidelined Friday would have required businesses to ask customers before printing a receipt, and then required that those not include coupons or advertisements unless also requested. AB 161 also sought to ban certain chemicals from being used on the paper receipts. In Los Angeles, cash register receipts made from thermal paper are not recyclable and should be placed in the black trash bin. The use of chemicals on paper receipts makes them undesirable to recyclers, according to the Department of Resources Recycling and Recovery, or CalRecycle. The American Forest and Paper Assn., an industry group that opposed the bill, estimated that 180,000 tons of paper receipts a year are generated nationwide. That is a small percentage of total paper waste, the group argued. "Public policy should be based on facts and sound science, not misinformation and unsubstantiated claims," said Jessica Mause of the opposition group Keep the Receipt, which was funded by the American Forest and Paper Assn. "We're pleased that legislators recognised paper receipts are not only preferred by the majority of consumers, but are also safe for consumers and employees." The Department of Justice estimated it would cost \$717,000 a year for the added staff to enforce AB 161, which carried financial penalties for businesses that did not comply. Consumers have taken to social media in recent years to express frustration with excessively long receipts that they photograph as props. Ting turned to a campy ploy to draw attention to the bill, having a legislative staff member wear a costume that looked like an oversize receipt, naming him Skip the Slip. CVS Health, a national pharmacy chain, has been a frequent target for criticism for printing coupon-filled receipts taller than consumers. Or, as Kimmel pointed out in his most recent dig at CVS: "I believe a receipt for a pack of gum should not be tall enough to ride Space Mountain."

LA Times, 30 August 2019

<http://www.latimes.com>

Regulatory Update

CHEMWATCH

EPA's 20 Proposed Low-Priority and High-Priority Chemical Substances: Comments are Due November 2019

2019-09-06

The United States Environmental Protection Agency (EPA) has been very diligent about meeting some of its key obligations under section 6(b) of the Toxic Substances Control Act (TSCA), 15 U.S.C. 2605(b), with its recent announcements on low priority and high priority substances. First, on 15 August 2019, EPA issued a proposed rulemaking that lists 20 chemical substances that the agency intends to designate as low-priority substances for which risk evaluation under TSCA is not warranted. Then on 23 August 2019, the agency proposed to designate 20 chemical substances as high-priority substances for risk evaluation. Both proposals allow for a 90-day comment period which closes on 13 November 2019 and 21 November 2019 respectively. With regard to low-priority chemicals, the 15 August Federal Register notice is a follow up to the 20 substances that EPA preliminarily proposed in March. The designated substances are mostly industrial solvents and cleaners and are listed below:

Low Priority Candidates		
	Chemical Name	CASRN
1	1-Butanol, 3-methoxy-, 1-acetate	4435-53-4
2	D-gluco-Heptonic acid, sodium salt (1:1), (2.xi.)-	31138-65-5
3	D-Gluconic acid	526-95-4
4	D-Gluconic acid, calcium salt (2:1)	299-28-5
5	D-Gluconic acid, .delta.-lactone	90-80-2
6	D-Gluconic acid, potassium salt (1:1)	299-27-4
7	D-Gluconic acid, sodium salt (1:1)	527-07-1
8	Decanedioic acid, 1,10-dibutyl ester	109-43-3
9	1-Docosanol	661-19-8
10	1-Eicosanol	629-96-9
11	1,2-Hexanediol	6920-22-5
12	1-Octadecanol	112-92-5
13	Propanol, [2-(2-butoxymethylethoxy)methylethoxy]-	55934-93-5
14	Propanedioic acid, 1,3-diethyl ester	105-53-3
15	Propanedioic acid, 1,3-dimethyl ester	108-59-8

The United States Environmental Protection Agency (EPA) has been very diligent about meeting some of its key obligations under section 6(b) of the Toxic Substances Control Act (TSCA), 15 U.S.C.

Regulatory Update

CHEMWATCH

	Low Priority Candidates	
16	Propanol, 1(or 2)-(2-methoxymethylethoxy)-, acetate	88917-22-0
17	Propanol, [(1-methyl-1,2-ethanediyl) bis(oxy)]bis-	24800-44-0
18	2-Propanol, 1,1'-oxybis-	110-98-5
19	Propanol, oxybis-	25265-71-8
20	Tetracosane, 2,6,10,15,19,23-hexamethyl-	111-01-3

Chemical substances placed on the low-priority list have been selected from EPA's Safer Chemicals Ingredients List, which includes chemicals that have been evaluated and determined to meet EPA's safer choice criteria. Generally, having a chemical substance placed on the low-priority risk evaluation list means that a risk evaluation is not warranted at this time. This month, EPA also published its *Approach Document for Screening Hazard Information for Low-Priority Substances under TSCA*, which described the literature review process for identifying and collecting the information used in the screening review for each proposed low-priority chemical substance. Comments on both the proposed low-priority designations and EPA's Approach Document are due 13 November 2019. During the 90-day comment period, stakeholders can weigh in on whether EPA has met the statutory obligation to have information "sufficient to establish" that the substances do not meet the standard for high-priority substances. A high-priority substance may present an unreasonable risk to human health or the environment. To date, comments were filed on only eight of the 20 substances initially identified as low priority, and no comments have been averse to the proposed low priority designations.

The implementing regulations found at 40 CFR §§ 702.7 and 702.9 also require that the agency carry out a prioritisation process for high priority chemical substances by a certain date. In fulfillment of that requirement, the agency is proposing the same 20 chemical substances it initiated during the prioritisation process on 21 March 2019. The list of chemical substances includes:

	High-Priority Candidates	
	Chemical Name	CASRN
1	1,3-Butadiene	106-99-0
2	Butyl benzyl phthalate (BBP) (1,2-Benzenedicarboxylic acid, 1-butyl 2-(phenylmethyl) ester)	85-68-7

Regulatory Update

CHEMWATCH

	High-Priority Candidates	
3	Dibutyl phthalate (DBP) (1,2-Benzenedicarboxylic acid, 1,2-dibutyl ester)	84-74-2
4	o-Dichlorobenzene (Benzene, 1,2-dichloro-)	95-50-1
5	p-Dichlorobenzene (Benzene, 1,4-dichloro-)	106-46-7
6	1,1-Dichloroethane	75-34-3
7	1,2-Dichloroethane	107-06-2
8	trans-1,2-Dichloroethylene (Ethene, 1,2-dichloro-, (1E)-)	156-60-5
9	1,2-Dichloropropane	78-87-5
10	Dicyclohexyl phthalate (1,2-Benzenedicarboxylic acid, 1,2-dicyclohexyl ester)	84-61-7
11	Di-ethylhexyl phthalate (DEHP) (1,2-Benzenedicarboxylic acid, 1,2-bis(2-ethylhexyl) ester)	117-81-7
12	Di-isobutyl phthalate (DIBP) (1,2-Benzenedicarboxylic acid, 1,2-bis(2-methylpropyl) ester)	84-69-5
13	Ethylene dibromide (Ethane, 1,2-dibromo-)	106-93-4
14	Formaldehyde	50-00-0
15	1,3,4,6,7,8-Hexahydro-4,6,6,7,8,8-hexamethylcyclopenta [g]-2-benzopyran (HHCB)	1222-05-5
16	4,4'-(1-Methylethylidene)bis[2,6-dibromophenol] (TBBPA)	79-94-7
17	Phosphoric acid, triphenyl ester (TPP)	115-86-6
18	Phthalic anhydride (1,3-Isobenzofurandione)	85-44-9
19	1,1,2-Trichloroethane	79-00-5
20	Tris(2-chloroethyl) phosphate (TCEP) (Ethanol, 2-chloro-, 1,1',1''-phosphate)	115-96-8

High priority substances may present an unreasonable risk of injury to health or the environment because of a potential hazard and a route of exposure under conditions of use, including an unreasonable risk to vulnerable subpopulations. Such a designation is not a conclusionary finding and EPA will make the determination without consideration of costs or other non-risk factors, as required by TSCA section 6(b)(1)(B). Final designation of a high-priority substance initiates the risk evaluation

Regulatory Update

CHEMWATCH

process that culminates in a finding of whether or not the chemical substance presents an unreasonable risk of injury to health or the environment under the conditions of use. In addition to the recommended designations for each of the low and high chemical substances, both proposed rules outline the agency's summary of the approach used to support the intended designations, the proposed designation for each of the chemical substances, and instructions on how to access the chemical-specific information, analysis and basis used by EPA to make the proposed designation for each chemical substance.

National Law Review, 29 August 2019

<http://www.natlawreview.com>

EUROPE

Relabelling obligations under the CLP Regulation (Regulation (EC) No. 1272/2008) in relation to Methylothiazolinone (MIT)

2019-09-06

The 13th Adaptation to Technical Progress (ATP) to the CLP Regulation (Commission Regulation (EU) No. 2018/1480) contains a number of new/revised harmonised classifications that require substances to be re-classified and labelled by 1st May 2020, including methylothiazolinone, 'MIT'. The legal obligation in the 13th ATP is to have MIT and all products containing MIT to be classified and labelled in accordance with new/revised harmonised classifications by the due date of applicability in the ATP (i.e. 1st May 2020). This means that suppliers have 18 months to sell stocks of existing products already placed on the market or in the supply chain. However, Article 30 of the CLP Regulation is also clear that following any changes to the classification and labelling where the revised classification is more severe or where new supplemental label elements are required, suppliers are required to update information on the label without undue delay, i.e. as soon as reasonably practicable. In a positive and constructive meeting, HSE met the British Coatings Federation (BCF) in June to discuss major supply issues around possible alternatives to MIT for use as preservatives in water-based paints. HSE explained its interpretation of the legal requirements around the relabelling obligations under the CLP Regulation in relation to MIT and outlined the potential wider enforcement/compliance issues. There is no obligation for formulators ('downstream users') to take back or re-

The 13th Adaptation to Technical Progress (ATP) to the CLP Regulation (Commission Regulation (EU) No.

Regulatory Update

CHEMWATCH

label products that have already been placed legally on the market but Article 4(9) of the CLP Regulation does place a 'soft' duty on suppliers in a supply chain to co-operate to meet the requirements of the CLP Regulation, which would include informing the supply chain of a more severe hazard classification for a substance. HSE, as one of the enforcing authorities for the CLP Regulation, will continue to take a pragmatic and proportionate approach to achieving compliance including information, advice and support depending on the individual circumstances on a case by case basis, but this will depend on the level of risk and the duty holders' understanding, behaviour and efforts made to achieve or to come into compliance. If suppliers are likely to find themselves non-compliant with this requirement, they are advised to contact the enforcement team (CRDEnforcement@HSE.gov.uk) as soon as possible.

HSE Biocides ebulletin, 29 August 2019

<http://www.hse.gov.uk/>

EC Requests Scientific Opinion on Three Coatings for Nano Forms of Zinc Oxide as a UV Filter in Dermally Applied Cosmetic Products

2019-09-06

On 19 August 2019, the Scientific Committee on Consumer Safety (SCCS) posted a request from the European Commission (EC) for a scientific opinion on three coatings for nano zinc oxide as an ultraviolet (UV) filter in dermally applied cosmetic products — methicone, silica, and isostearic acid. SCCS previously reviewed nano zinc oxide and the coatings triethoxycaprylylsilane, dimethicone, dimethoxydiphenylsilanetriethoxycaprylylsilane cross-polymer, and octyl triethoxy silane. SCCS concluded that the use of nano zinc oxide as a UV filter in sunscreens, with the characteristics laid out in its opinion, and at a concentration of up to 25%, can be considered to "pose no or limited risk for use on the skin as UV filter in sunscreen formulations." Regarding the use of other coatings not covered in the opinion, SCCS concluded that "[o]ther cosmetic ingredients can be used as coatings as long as they are demonstrated to the SCCS to be safe and do not affect the particle properties related to behaviour and/or effects, compared to the nanomaterials covered in the current opinion." In its request, the EC asks whether:

On 19 August 2019, the Scientific Committee on Consumer Safety (SCCS) posted a request from the European Commission (EC) for a scientific opinion on three coatings for nano zinc oxide as an ultraviolet (UV) filter in dermally applied cosmetic products — methicone, silica, and isostearic acid.

Regulatory Update

CHEMWATCH

- SCCS considers safe the use of methicone with a maximum concentration of 3% as coating on nano zinc oxide for use as UV filter in dermally applied cosmetic products;
- SCCS considers safe the use of methicone with a maximum concentration of 3% when applied in combination with 8% silica as coatings on nano zinc oxide for use as UV filter in dermally applied cosmetic products;
- SCCS considers safe the use of isostearic acid with a maximum concentration of 4% when applied in combination with 2.0% triethoxycaprylylsilane as coatings on nano zinc oxide for use as UV filter in dermally applied cosmetic products; and
- SCCS has any further scientific concerns regarding the use of nano zinc oxide coated with the above-mentioned materials when used as UV filter in dermally applied cosmetic products.

The deadline for SCCS's opinion is March 2020.

Nano & Other Emerging Technologies Blog, 20 August 2019

<http://nanotech.lawbc.com>

Germany AwSV List of published WGK classifications updated

2019-09-06

On 23 August 2019, the German Ordinance on Facilities Handling Substances That Are Hazardous to Water (AwSV) List of published water hazard class (WGK) classifications was updated. The following substances were newly assigned a WGK:

- Acetic acid ethenyl ester, polymer with ethene and 1-propene (average MW 4300 g/mol): WGK 1 (slightly hazardous to water)
- 1-butyl-1,2-dihydro-6-hydroxy-4-methyl-2-oxonicotinonitrile: WGK 1 (slightly hazardous to water);
- 6-cyclohexyl-1-hydroxy-4-methylpyridin-2(1H)-one, compound with 2-aminoethanol (1:1): WGK 3 (highly hazardous to water)
- (+/-)-9-Fluoro-2,3-dihydro-3-methyl-10-(4-methyl-1-piperazinyl)-7-oxo-7H-pyrido[1,2,3-de]-1,4-benzoxazine-6-carboxylic acid: WGK 3 (highly hazardous to water)

Yorda's Hive, 27 August 2019

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

On 23 August 2019, the German Ordinance on Facilities Handling Substances That Are Hazardous to Water (AwSV) List of published water hazard class (WGK) classifications was updated.

Bulletin Board

SEP. 13, 2019

Regulatory Update

CHEMWATCH

REACH Update

CHEMWATCH

New proposal to harmonise classification and labelling

2019-09-06

The European Chemicals Agency has published one proposal to harmonise classification and labelling. The proposal was submitted for:

Melamine (EC 203-615-4, CAS 108-78-1) by Germany. Further information is available at: [Registry of CLH intentions until outcome](#)

ECHA News, 4 September 2019

<http://echa.europa.eu>

Public consultations on harmonised classification and labelling

2019-09-06

The European Chemicals Agency (ECHA) is seeking comments on the harmonised classification and labelling proposal for 5 substances. The substances are:

- N-(2-nitrophenyl)phosphoric triamide (EC 477-690-9, CAS 874819-71-3). A public consultation is also ongoing for four isocyanates which belong to the same group of substances:
- 1,3-bis(1-isocyanato-1-methylethyl)benzene (EC 220-474-4, CAS 2778-42-9);
- 1,3-bis(isocyanatomethyl)benzene (EC 222-852-4, CAS 3634-83-1);
- 2,4,6-triisopropyl-m-phenylene diisocyanate (EC 218-485-4, CAS 2162-73-4); and
- 1,5-naphthylene diisocyanate (EC 221-641-4, CAS 3173-72-6).

The deadline for comments is 25 October 2019. Further information is available at: [Give comments](#)

ECHA News, 4 September 2019

<http://echa.europa.eu>

Take a look at our interactive table of elements

2019-09-06

2019 is the International Year of the Periodic Table of Elements. Did you know that you can find 93 of the elements in ECHA's database of chemicals? Click on the elements and get comprehensive information on

The European Chemicals Agency has published one proposal to harmonise classification and labelling.

REACH Update

CHEMWATCH

the elements' properties, how they are used and the precautions needed to use them safely: [Interactive table of elements](#)

ECHA News, 4 September 2019

<http://echa.europa.eu>

Four proposals to identify substances of very high concern (SVHCs)

2019-09-06

The European Chemicals Agency has published four proposals to identify substances of very high concern (SVHC). The substances and examples of their uses are:

- [Perfluorobutane sulfonic acid \(PFBS\) and its salts](#) (EC -, CAS -). The substances are used in polymer production;
- [Diisohexyl phthalate](#) (EC 276-090-2, CAS 71850-09-4). The substance is not registered under REACH;
- [2-benzyl-2-dimethylamino-4'-morpholinobutyrophenone](#) (EC 404-360-3; CAS 119313-12-1). The substance is used in polymer production; and
- [2-methyl-1-\(4-methylthiophenyl\)-2-morpholinopropan-1-one](#) (EC 400-600-6; CAS 71868-10-5). The substance is used in polymer production.

The deadline for comments is 18 October 2019. Further information is available at: [Identifying substances of very high concern](#)

ECHA News, 4 September 2019

<http://echa.europa.eu>

Substance evaluation conclusions published

2019-09-06

The European Chemicals Agency (ECHA) has published 2 new substance evaluation conclusion documents. The new substance evaluation conclusion documents are available on ECHA's website for:

- [2-ethyl-2-\[\[\[\(1-oxoallyl\)oxy\]methyl\]-1,3-propanediyl diacrylate](#) (EC 239-701-3, CAS 15625-89-5), added to the CoRAP list in 2014 and evaluated by France; and
- [2,2'-methyliminodiethanol](#) (EC 203-312-7, CAS 105-59-9), added to the CoRAP list in 2013 and evaluated by United Kingdom.

Further information is available at:

The European Chemicals Agency has published four proposals to identify substances of very high concern (SVHC).

REACH Update

CHEMWATCH

- [Community rolling action plan](#)
- [Substance evaluation](#)

ECHA News, 4 September 2019

<http://echa.europa.eu>

Janet's Corner

CHEMWATCH

Environmental Impact Statement

2019-09-06



“Have you got an Environmental Impact Statement for that castle, son?”

Hazard Alert

CHEMWATCH

Mercury

2019-08-27

Mercury is a naturally occurring element that is found in air, water and soil. It exists in several forms: elemental or metallic mercury, inorganic mercury compounds, and organic mercury compounds. [1] It has the chemical symbol Hg and atomic number 80. [2] It is the only common metal which is liquid at ordinary temperatures. Mercury is sometimes called quicksilver. It is a heavy, silvery-white liquid metal. It is a rather poor conductor of heat if compared with other metals but it is a fair conductor of electricity. It alloys easily with many metals, such as gold, silver, and tin. These alloys are called amalgams. The most important mercury salts are mercuric chloride HgCl_2 (corrosive sublimate - a violent poison), mercurous chloride Hg_2Cl_2 (calomel, still used in medicine occasionally), mercury fulminate ($\text{Hg}(\text{ONC})_2$, a detonator used in explosives) and mercuric sulphide (HgS , vermilion, a high-grade paint pigment). Mercury metal has many uses. Because of its high density it is used in barometers and manometers. It is extensively used in thermometers, thanks to its high rate of thermal expansion that is fairly constant over a wide temperature range. Its ease in amalgamating with gold is used in the recovery of gold from its ores. [3]

USES

Mercury metal is used in industry as a liquid electrode in the manufacture of chlorine and sodium hydroxide by electrolysis of brine. Mercury is still used in some electrical gear, such as switches and rectifiers, which need to be reliable, and for industrial catalysis. Much less mercury is now used in consumer batteries and fluorescent lighting, but it has not been entirely eliminated.

Mercury compounds have many uses. Calomel (mercurous chloride, Hg_2Cl_2) is used as a standard in electrochemical measurements and in medicine as a purgative. Mercuric chloride (corrosive sublimate, HgCl_2) is used as an insecticide, in rat poison, and as a disinfectant. Mercuric oxide is used in skin ointments. Mercuric sulphate is used as a catalyst in organic chemistry. Vermilion, a red pigment, is mercuric sulphide; another crystalline form of the sulphide (also used as a pigment) is black. Mercury fulminate, $\text{Hg}(\text{CNO})_2$, is used as a detonator. [3]

SOURCES AND ROUTES OF EXPOSURE [1,4]

Mercury is found in the earth's crust. It is also found in many rocks including coal. When coal is burned, mercury is released into the

Mercury is a naturally occurring element with the chemical symbol Hg and atomic number 80.

Hazard Alert

CHEMWATCH

environment. Coal-burning power plants are the largest human-caused source of mercury emissions to the air in the United States, accounting for over 50 percent of all domestic human-caused mercury emissions. Mercury compounds are manufactured in small amounts for specialty uses, such as chemical and pharmaceutical applications. Larger quantities of these compounds are generated as byproducts from pollution control activities at gold mines or in waste. Elemental mercury is processed in the U.S. from by-product mercury compounds, and an unknown quantity of mercury compounds is imported into the United States for conversion to elemental mercury. Organic mercury compounds like methyl mercury can enter the body readily through three routes -via the lungs, skin and stomach. The main human exposure to mercury is through ingestion of fish that contain methyl mercury. Mercury is extremely volatile in its elemental form and can give off mercury vapour at room temperature. This vapour can be inhaled into the lungs and passed into the blood stream. Based on available science, normal air concentrations of mercury vapour, averaging 1.6 nanograms per cubic meter of air, do not appear to be a cause for concern. However, inhalation can be a significant route of exposure when mercury-silver amalgam is used in dental fillings. Dermal contact is also a route of exposure to mercury with alkyl mercury compounds being particularly notorious. Liquid mercury may pass through the skin and into the blood stream causing it to be lethal at some doses. In 1997, a researcher named Karen Wetterhahn, from Dartmouth College in New Hampshire, died when a single drop of dimethylmercury passed through her protective latex glove and through her skin.

HEALTH EFFECTS [1,5]

The factors that determine how severe the health effects are from mercury exposure include these:

- the chemical form of mercury;
- the dose;
- the age of the person exposed (the foetus is the most susceptible);
- the duration of exposure;
- the route of exposure -- inhalation, ingestion, dermal contact, etc.; and
- the health of the person exposed.

Mercury exists in three chemical forms. They each have specific effects on human health.

- Methylmercury

Hazard Alert

CHEMWATCH

- Elemental mercury
- Other mercury compounds (inorganic and organic)

Mercury can cause effects in the central and peripheral nervous systems, lungs, kidneys, skin and eyes in humans. It is also mutagenic and affects the immune system [Hathaway et al. 1991; Clayton and Clayton 1981; Rom 1992].

Acute Effects

Acute exposure to high concentrations of mercury causes severe respiratory damage. Acute inhalation of mercury vapour may result in toxicity similar to metal fume fever including chills, nausea, general malaise, tightness in the chest, chest pains, dyspnea, cough, stomatitis, gingivitis, salivation, and diarrhoea [ACGIH 1991; Hathaway et al. 1991].

Chronic Effects

Chronic exposure to lower levels of mercury is primarily associated with central nervous system damage [Hathaway et al. 1991]. In addition, it is associated with behavioural changes and alterations in peripheral nervous system [ACGIH 1991]. Pulmonary effects of mercury inhalation include diffuse interstitial pneumonitis with profuse fibrinous exudation [Gosselin 1984]. Glomerular dysfunction and proteinuria have been observed mercury exposed workers [ACGIH 1991]. Chronic mercury exposure can cause discoloration of the cornea and lens, eyelid tremor and, rarely, disturbances of vision and extraocular muscles [Grant 1986]. Delayed hypersensitivity reactions have been reported in individuals exposed to mercury vapour [Clayton and Clayton 1981]. Chronic exposure to mercury may result in weakness, fatigue, anorexia, weight loss, and disturbance of gastrointestinal function. A tremor may develop beginning with the fingers, eyelids, and lips which may progress to generalised trembling of the entire body and violent chronic spasms of the extremities. Parallel with development of the tremors, behavioural and personality changes may develop including increased excitability, memory loss, insomnia, and depression. The skin may exhibit abnormal blushing, dermatographia, excessive sweating and irregular macular rashes. Severe salivation and gingivitis is also characteristic of chronic toxicity [Hathaway et al. 1991; Gosselin 1984]. Another manifestation of chronic mercury exposure is characterised by apathy, anorexia, flush, fever, a nephrotic syndrome with albuminuria and generalised oedema, diaphoresis, photophobia, insomnia and a pruritic and sometimes painful scaling or peeling of the skin of the hands and feet with bullous lesions [Gosselin 1984].

Hazard Alert

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Mutagenicity

Mercury vapour is reported to be mutagenic in humans, causing aneuploidy in lymphocytes of exposed workers [Hathaway et al. 1991].

SAFETY [6]

First Aid Measures

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

Exposure Controls & Personal Protection

Engineering Controls

Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapours below their respective threshold limit

Hazard Alert

CHEMWATCH

value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection

- Face shield;
- Full suit;
- Vapour respirator (be sure to use an approved/certified respirator or equivalent);
- Gloves;
- Boots.

In the event of a large spill, the following personal protection should be used:

- Splash goggles;
- Full suit;
- Vapour respirator;
- Boots;
- Gloves;
- A self contained breathing apparatus should be used to avoid inhalation of the product.

Note: Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

REGULATIONS [6,7]

Exposure Limits

United States

- TWA: 0.025 from ACGIH (TLV) [United States]
- SKIN TWA: 0.05 CEIL: 0.1 (mg/m³) from OSHA (PEL) [United States]
- The EPA has set a limit of 2 parts of mercury per billion parts of drinking water (2 ppb).
- The Food and Drug Administration (FDA) has set a maximum permissible level of 1 part of methylmercury in a million parts of seafood (1 ppm).
- The Occupational Safety and Health Administration (OSHA) has set limits of 0.1 milligram of organic mercury per cubic metre of workplace air (0.1 mg/m³) and 0.05 mg/m³ of metallic mercury vapour for 8-hour shifts and 40-hour work weeks.

Hazard Alert

CHEMWATCH

Australia

- Worksafe Australia: The eight-hour time weighted average (TWA) exposure limit is 0.05mg/m³. Mercury bichloride is also considered to be toxic by inhalation, skin contact, or swallowing.
- Australian Drinking Water Guidelines (NHMRC and ARMCANZ, 1996): Maximum of 0.001 mg/L (i.e. 0.000001 g/L)

United kingdom

- Inhalation TWA: 0.025 (mg/m³) [United Kingdom (UK)]

REFERENCES

[1] <http://www.epa.gov/hg/about.htm>

[2] [http://en.wikipedia.org/wiki/Mercury_\(element\)](http://en.wikipedia.org/wiki/Mercury_(element))

[3] <http://www.lenntech.com/periodic/elements/hg.htm>

[4] http://people.uwec.edu/piercech/hg/mercury_tox/exposure.htm

[5] <http://www.osha.gov/SLTC/healthguidelines/mercuryvapor/recognition.html/>

[6] <http://www.sciencelab.com/msds.php?msdsId=9927224>

[7] <http://www.atsdr.cdc.gov/toxfaqs/tf.asp?id=113&tid=24>

[8] <http://www.npi.gov.au/substances/mercury/health.html>

Gossip

CHEMWATCH

Making microbes that transform greenhouse gases

2019-08-27

Researchers at the University of South Florida are harnessing the power of human physiology to transform greenhouse gases into usable chemical compounds—a method that could help lessen industrial dependence on petroleum and reduce our carbon footprint. The new biologically-based technique, published in *Nature Chemical Biology*, was developed by USF Professor Ramon Gonzalez, Ph.D., and his research team. It utilizes the human enzyme, 2-hydroxyacyl-coenzyme A lyase (HACL), to convert specific one-carbon (C1) materials into more complex compounds commonly used as the building blocks for an endless number of consumer and industrial products. “In humans, this enzyme degrades branched chain fatty acids,” Gonzalez said. “It basically breaks down long carbon chains into smaller pieces. We needed it to do the opposite. So, we engineered the process to work in reverse—taking single carbon molecules and converting them into larger compounds. By manipulating the DNA encoding the enzyme, researchers are able to insert the modified enzyme into *E. coli* microorganisms, which act as hosts. When those microbes are introduced to C1 feedstock, such as methanol, formaldehyde, formate, carbon dioxide and methane, a metabolic bioconversion process takes place, transforming the molecules into more complex compounds. This research represents a significant breakthrough in biologically-based carbon conversion and has the potential to transform current petrochemical processes as well as reduce the amount of greenhouse gas released into the atmosphere during crude oil production. “When crude oil is pumped out of the ground, it comes with a lot of associated gas,” Gonzalez said. “Much of the time, that gas is burned off through flaring and released into the atmosphere. We see that gas as a wasted resource.” Through their work, Gonzalez believes he and his team have engineered a method to utilize that wasted resource in a way that is economically feasible and enticing for oil manufacturers. Right now, the vast majority of oil production facilities utilize flaring to burn-off gas like methane. While that process is wasteful, according to Gonzalez, it is also inefficient and leads to the release of excess, unburned methane into the atmosphere as well as additional carbon dioxide produced through the burning process. By implementing the USF-developed technique, oil producers could not only better manage their impact on the environment but also begin producing valuable chemical compounds like ethylene glycol and glycolic acid—molecules that are used in the production of plastics, cosmetics, polymers, cleaning solutions and much more. Traditionally, the building blocks for these products are made using petroleum. So, while employing

Researchers at the University of South Florida are harnessing the power of human physiology to transform greenhouse gases into usable chemical compounds—a method that could help lessen industrial dependence on petroleum and reduce our carbon footprint.

Gossip

CHEMWATCH

the bioconversion method would help reduce greenhouse gas emissions, it also has the potential to reduce the overall dependence on petroleum—multiple benefits that Gonzalez hopes will attract manufacturers to explore adopting their process. “While this study details the overarching science that makes all of this possible, we are currently working with partners in the private sector to try and implement our technique,” Gonzalez said. “It’s exciting to be able to take this project from its initial inception all the way to industrial implementation and hopefully have a meaningful impact on not just the industry but to the environment as well.”

Phys.org, 13 August 2019

<http://phys.org>

Rubik’s cube with a chemical twist

2019-08-27

The Rubik’s cube—a popular toy puzzle that has confounded adults and children since the 1980s—has been recreated with chemistry. An international group of researchers have created a working Rubik’s cube held together only by chemical bonds (Adv. Mater. 2019, DOI: 10.1002/adma.201902365). In January 2018, University of Texas at Austin’s Jonathan Sessler was at a meeting presenting work his lab had done making 2-D patterns from tiles of coloured hydrogels. Philip A. Gale, a chemist at the University of Sydney who specialises in supramolecular chemistry and was a postdoc in Sessler’s lab in the 1990s, challenged him to make the materials into a Rubik’s cube. “The patterns in Jonathan’s arrays of gels reminded me of the face of a Rubik’s Cube,” Gale says. “I wondered whether it would be possible to construct a functioning cube from gel blocks which would allow the blocks to be easily reconfigured.” Sessler put postdoc Xiaofan Ji on the project right away. The seemingly whimsical task turned out to be a tremendous challenge. Ji had problems creating hydrogels with the six colours needed to make a Rubik’s cube while also retaining the material’s structural integrity. It was only when Ji moved on to a second postdoc, with Ben Zhong Tang at Hong Kong University of Science and Technology, that he discovered the right ingredients: compounds Tang developed that, thanks to aggregation, fluoresce when they’re embedded in solid films. They then needed material with variable stickiness so that the coloured tiles could be firmly attached, but the cubes could still be rotated to play the game. The team settled on a hydrogel that forms acylhydrazone crosslinks from the reaction of a diacylhydrazine precursor with a tetraformyl partner. After being in contact for a short

Coloured hydrogel tiles could find use as smart chemical arrays

Gossip

CHEMWATCH

period of time—about an hour—tiles made of this hydrogel can be stuck and unstuck with ease. But when enough acylhydrazone crosslinks are made—usually over a 24-h period—the material becomes permanently stuck, which makes the tiles stay together. The researchers created 27 small cubes with six coloured tiles attached to each and left them for a day. They then assembled the cubes into a $3 \times 3 \times 3$ Rubik's cube. After an hour, they were able to rotate the cube just as if it were the classic toy puzzle. "Because this is all chemical, if we want to cheat, all we do is pick up one cube, rotate it so that it matches the pattern and stick it back in," Sessler says. "So, we can solve the Rubik's cube in a way that you can't with a plastic Rubik's cube." There is one hitch: after 24 h, the Rubik's cube locks into place. The same mechanism that allowed the team to stick on the coloured tiles made the game unplayable. "We've basically made a material that, like plaster of Paris or modelling clay, over time becomes harder," Sessler says. Although recreating the fad toy was fun, Sessler says that isn't his ultimate aim. He'd like to create arrays from tiles of smart soft materials that rely on something like Tang's fluorescent materials to change colour in the presence of chemical stimuli. Such arrays could communicate medical information when placed on a person's skin or guide robots performing chemical reactions, such as an acid-base titration. "It's elegant work and opens up a new approach to the production of arrays of sensors," Gale says. "I'm delighted they've met the challenge."

Chemical & Engineering News, 9 August 2019

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

How buildings can cut 80% of their carbon emissions by 2050

2019-08-27

Energy use in buildings—from heating and cooling your home to keeping the lights on in the office—is responsible for over one-third of all carbon dioxide (CO₂) emissions in the United States. Slashing building CO₂ emissions 80% by 2050 would therefore contribute significantly to combatting climate change. A new model developed by researchers at two U.S. national laboratories suggests that reaching this target will require the installation of highly energy-efficient building technologies, new operational approaches, and electrification of building systems that consume fossil fuels directly, alongside increases in the share of electricity generated from renewable energy sources. Their work appears August 15 in the journal *Joule*. "Buildings are a substantial lever to pull in trying to reduce total national CO₂ emissions since they are responsible for

A new model developed by researchers at two U.S. national laboratories suggests that reaching this target will require the installation of highly energy-efficient building technologies, new operational approaches, and electrification of building systems that consume fossil fuels directly, alongside increases in the share of electricity generated from renewable energy sources.

Gossip

CHEMWATCH

36% of all energy-related emissions in the U.S.," says Jared Langevin, a research scientist at Lawrence Berkeley National Laboratory and lead author of the study. "Because the buildings sector uses energy in a multitude of ways and is responsible for such a large share of electricity demand, buildings can help accelerate the cost-effective integration of clean electricity sources on top of contributing direct emissions reductions through reduced energy use." To estimate the magnitude of possible CO₂ emissions reductions from the U.S. buildings sector over several decades, the researchers considered three types of efficiency measures--technologies with higher energy performance than typical alternatives, such as dynamic windows and air sealing of walls, sensing and control strategies that improve the efficiency of building operations, and conversion of fuel-fired heating and water heating equipment to comparable systems that can run on electricity. They also considered how parallel incorporation of renewable energy sources into the electric grid would shift emissions reduction estimates from each building efficiency measure and the buildings sector as a whole. "While building CO₂ emissions are quite sensitive to the greenhouse gas intensity of the electricity supply, measures that improve the efficiency of energy demand from buildings need to be part of the solution," Langevin says. "Getting close to the 80% emissions reduction target requires concurrent reductions in building energy demand, electrification of this demand, and substantial penetration of renewable sources of electricity--nearly half of annual electricity generation by 2050. Moreover, buildings can support the cost-effective integration of variable renewable sources by offering flexibility in their operational patterns in response to electric grid needs." Examining results for specific efficiency measures, the researchers identified two particularly promising avenues for reducing emissions. The first involves energy-saving retrofits and upgrades to walls, windows, roofs, and insulation--the so-called building "envelope"--approaches that can also boost living and working comfort for building occupants. The second focuses on smart software that is capable of optimizing when, where, and to what degree energy-intensive building heating, cooling, lighting, and ventilation services should be provided. The researchers stress that bringing these strategies and emissions benefits to fruition is contingent upon complementary action by policymakers, manufacturers and vendors, building service professionals, and consumers. "Regulations and incentives that support the sale of more efficient, less carbon-intensive technology options, early-stage research and development that drives breakthroughs in technology performance, aggressive marketing of those technologies once developed, training for local contractors charged with technology installation, and consumer willingness to consider purchasing newer

Gossip

CHEMWATCH

options on the market are all needed to achieve the 80% emissions reduction goal by 2050," says Langevin. To promote the transparency and repeatability of their analysis, the researchers have published their efficiency measures and results data, all generated using Scout, a model that is annually updated to reflect key changes in the building energy use and electricity supply landscapes. "We look forward to periodically revisiting this analysis to reassess where emissions from the buildings sector stand relative to the 2050 target, under both business-as-usual and more optimistic scenarios of efficient technology adoption and renewable electricity supply," Langevin says.

EurekaAlert, 15 August 2019

<http://www.eurekaalert.org>

Why are people still dying of malaria when we have a treatment?

2019-08-27

A 9-year-old child is locked between his mother's legs, refusing to have the blood test that could save his life. That is a regular sight at Brian Gitta's nearest clinic in Kampala, Uganda, where people wait for hours in long queues to learn if they have malaria, one of the leading causes of death in the country. Worldwide, 219 million people get malaria each year and 435,000 people die of the disease. More than 90 per cent of those deaths are in Africa, according to the World Health Organization. We can treat malaria, but accurate diagnosis is essential: the drugs targeting the mosquito-borne parasite that causes the disease can harm people who don't have it. Diagnostic tests take time and, worse still, they are invasive. The most widely used method involves analysing a blood sample under a microscope, a process that can take up to an hour. Rapid diagnostic tests are becoming more widespread, but they still require people to give a blood sample. Gitta thought there must be an easier way and when he started studying at Makerere University in Uganda 2012, he set out to find it. Now, he and his team are running a clinical trial for a portable, non-invasive device that uses light to identify malaria in the bloodstream in just 2 minutes. He hopes it won't only save precious time for people with the disease, but also help us to track malaria around the world.

Why did you take on such a huge problem?

Growing up in Uganda, I went to a traditional primary school and got involved in a computer club. I was 9 years old and I was meant to be

Ugandan inventor Brian Gitta created a way to test for malaria without a blood sample. He hopes it will help people get vital treatment faster, and enable us to track and ultimately beat the disease

Gossip

CHEMWATCH

learning Microsoft Word, but also ended up playing games. I liked it so much, I kept wanting to come back and complete the next level. I eventually became head of the computing club at high school and then went on to study computer science at university. I was in my first year when I thought, "how can I use all of these software developments and skills that I've learned to solve the problem of malaria?"

Why focus on malaria and not another disease?

Malaria is something that people where I live are fighting every day. My friends and I all experienced a lot of malaria growing up.

How many times have you had it?

I can't even count how many times I had it as a child; at least once a year. It's tough – you're hospitalised, you're throwing up, you've got a high temperature, you can't eat.

Is the situation still as bad?

Things have improved: we've got better medication and free mosquito nets. But we haven't seen much change in the diagnosis. I asked myself, "Why is it that people are still dying when we have the medication? Why are people still suffering, just to get a simple diagnostic test done?" When I first started looking into it, we didn't really have an understanding of how malaria affects the body. We needed to understand the mechanics of malaria, and we needed to understand a lot of things in microbiology and parasitology. "While people wait for a malaria diagnosis, they aren't going to school, they aren't going to work"

Tell us more about the problems with the current diagnostic tests.

Doctors use a blood test and it takes time to get a diagnosis. People can be queuing for hours. It takes a skilled doctor to do the analysis and they can be sitting there all day staring down a microscope. I wanted to figure out how we can make that process easier, how we can take the patients' pain away and how to do it quickly. It isn't just the diagnosis: while people are queuing, they aren't going to school, they aren't going to work, they aren't earning money.

What was your solution?

We did lots of research and found that when a person is infected with malaria, the parasite that causes the disease changes the physical and chemical composition of their blood cells. It also creates a crystal-like structure in the bloodstream. Our solution uses the principles of light

Gossip

CHEMWATCH

scattering and magnetism to map out the differences between malaria-infected and normal blood cells. We use this information together with a light beam that is shone onto the finger to detect whether malaria is in the blood or not.

Did you have an “aha” moment when you figured it all out?

Our device had to go through lots of iterations. The first few prototypes failed completely. There were lots of things that interfered with the light beam, like the temperature of the skin, which changes when you have a fever. There was never really an “aha” moment, more like constant research that gradually moved towards the solution. Once we got there, we started a company called Matibabu, which means “treatment” in Swahili. We are now starting a clinical trial and looking at improving consistency. We’re testing it on 500 people and then, if the outcomes are good, we will start a trial of 10,000 people, so that we can get verification before we roll it out.

How expensive will your approach be compared with standard blood tests?

We are still working out the costs, but our plan was always for it to be cheaper than a microscope. And in terms of value for the community and the time it takes to get a diagnosis, its worth is more than just the cost of the test itself.

You have a bigger vision for how it can be used, though, right?

Yes. The device also collects data in real time, and we can use this to look at the geographical distribution and evolution of malaria cases. This data is passed on to organisations involved in malaria control programs. We’re also looking at letting pharmaceutical companies use the data so they can provide the right medications to the communities that need it most.

Have you come across any unexpected challenges during development?

When we did some test cases, a mother came in to have a diagnosis for her child who had a high fever. Her kid was malaria negative. The mother wasn’t convinced, so she went next door and had the blood drawn as well. This made us understand that we also have to change the way that people think about new technologies.

You’re 27, but you have already created this potentially game-changing technology. What will you do next?

I want to grow the company in order to close the gaps between communities and their rightful access to healthcare. I would like to build

Gossip

CHEMWATCH

more technologies that offer better diagnoses. This definitely won't be the last device we develop.

New Scientist, 21 August 2019

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

Inside China's attempt to boost crop yields with electric fields

2019-08-27

At first blush, the huge commercial greenhouse on the outskirts of Beijing doesn't seem unusual. Inside, lettuces sit in neat rows and light pours in through the glass above. But there is a soft hum and an intense feeling in the air, almost as if a thunderstorm is on the way. The most obvious sign that this is no ordinary growing space is the high-voltage electrical wiring strung over the crops. This place may be different, but it is far from unique. Over the past few years, greenhouses like this have sprouted up across China, part of a government-backed project to boost the yield of crops by bathing them in the invisible electric fields that radiate from power cables. From cucumbers to radishes, the results are, apparently, incredible. "The overall quality is excellent," says Liu Binjiang, the lead scientist on the project. "We're really entering a golden age for this technology." Using electricity to boost plant growth – not by powering heaters or sprinkler systems, but simply by exposing plants to an electric field – is an old idea. It is also controversial. Electroculture was tested in Europe many decades ago and found wanting, with the results too inconsistent to be any use. The mechanism was also mysterious: no one knew how or why electric fields might boost growth. So, what exactly is going on in China's new greenhouses? Can you really improve agriculture through the power of electric fields – and if so, how? It was Finnish physicist Karl Selim Lemström who introduced the world to the idea of electroculture in the 1880s. He was studying the northern lights in Lapland when he noticed that trees grew well there in spite of the short growing season. He suggested it might be because of the electrical field produced by charged particles rushing into Earth's atmosphere to create the aurora. Lemström carried out tests with plants growing under electric wires and achieved mixed results. In one experiment conducted in a field in Burgundy, France, he saw that "carrots gave an increase of 125 per cent and peas 75 per cent". In 1896, a reporter for the North American Review breathlessly described Lemström's work and that of rivals in France and Russia, writing: "Gardens that have been stimulated by the atmospheric electricity... have increased their growth and products by fifty per cent. Vineyards have been experimented

In greenhouses across China, scientists are exposing lettuces and cucumbers to powerful electric fields in an attempt to make them grow faster. Can electroculture work?

upon, and the grapes produced have not only been larger in size and quantity, but richer in sugar and alcohol. The flowers have attained a richer perfume and more brilliant colours." Before long the results were replicated in the UK. The botanist J.H. Priestley reported a 17 per cent increased yield of cucumbers with Lemström's technique, while physicist Oliver Lodge cultivated a large field of wheat with wires strung above it and saw a 24 per cent boost in the grain harvest. The words in the North American Review seemed to ring true: "It is difficult to explain why the electric current so marvellously affects the growth of plants, but the fact that such stimulation does occur cannot be denied." At the end of the first world war in 1918, the UK set up the Electro-Culture Committee, a group of scientists and farmers, and asked it to find out whether electroculture was worth pursuing. The committee experimented through the 1920s with wheat, oats, peas and potatoes, but the results were frustratingly inconsistent. This, together with the cost of electricity, eventually doomed electroculture. "Increases of 20 per cent can hardly be considered economic even if obtained in most years," said the committee's final report in 1936. Nevertheless, the scientists seemed to think the effect was real, if erratic. The US Department of Agriculture conducted some experiments at Arlington Experimental Farm, near Washington DC, but these, too, were difficult to interpret. Many patents were taken out, but the technique never took off in the US either. Research in electroculture slowed to a trickle for some 50 years. Then, in the 1980s, Liu began looking into the technique as a researcher at the Inner Mongolia Agricultural University in Hohhot, China. He says he had been fascinated by the effect of lightning on soil nutrients, and began looking into whether electricity boosted the growth of wheat and barley. Around this time, the Chinese government began giving out grants in agricultural science, allowing him to expand his study.

Power plants

Liu began developing what he calls the "space electric field" method. There is usually a natural vertical electric potential gradient in the air of about 100 volts per metre. Liu began setting up experiments in greenhouses where that was increased to between 700 and 20,000 volts per metre. Electrical wires were strung above the crops and the field emanated from these. He began seeing impressive improvements in crop yields: increases in lettuce and cucumber by up to 40 per cent, and similar improvements for potato, radish and fennel. Liu worked with a company in the southern Chinese city of Shenzhen to develop a commercial generator to power the wires in 2000. Within a few years, electroculture greenhouses were being

Gossip

CHEMWATCH

set up in Beijing, Dalian and Tianjin. The motivation wasn't just to increase yields, though. In China, there is widespread public wariness about food safety, following several high-profile incidents in which illegal pesticides were found on produce. Fruit and vegetables are almost never eaten raw or unpeeled out of concern over harmful chemicals. Because of this, there was interest in electroculture as a possible alternative to pesticides. "There's a big focus on eco-friendly farming right now," says Liu. "We are looking at how to combine physics-based and biological techniques to reduce pesticide use, while still maintaining crop yield." In 2013, Liu, now based at the Dalian City Academy of Agricultural Sciences, introduced a second electroculture technique called "charged cultivation". This involves overhead wires again, but this time the current they generate runs through the plants, says Tong Yuxin at the Chinese Academy of Agricultural Sciences (CAS), which is supporting Liu's work. Touch the plants, and you would get a mild shock. This effect drives insects away, says Liu. The electric field also removes microorganisms from the greenhouse air, he says, because when an electric field is discharged, it produces radicals, chemical species that can kill airborne bacteria. A report from CAS this year looking at electroculture says the yields of crops are generally increased by 30 per cent. It isn't easy to assess the scientific validity of Liu's work. He and his colleagues haven't published much of their research in international journals, though he has published more than 100 papers in China. *New Scientist* asked several Chinese-speaking plant scientists to look at these. They found the research unconvincing. "The statistics were generally weak and replications were not clear," says plant scientist Yang Aijun at CSIRO, Australia's national science agency. Yet Liu isn't the only researcher working on electroculture. Erika Bustos at the Centre of Research and Technological Development in Electrochemistry in Querataro state, Mexico, has been exploring its effects on *Arabidopsis thaliana*. This small flowering plant is a member of the same family as cabbages and is often used as a botanical guinea pig. In a 2016 study, Bustos set up trays of the plants and stuck electrodes in the soil at either end to create an electrical circuit. It was a small trial and a different method to Liu's, but the plants did grow faster and thicker, as long as the current wasn't cranked up too high. Bustos says she and her colleagues also have unpublished results showing that electrodes in the soil can increase the yield of wheat and maize by up to 85 per cent.

Grow with the flow

Let's assume something is going on. How could this effect work? We know that plants make use of electricity. Some plant cells build up and release

Gossip

CHEMWATCH

electric charge by moving ions like calcium and magnesium around their cells. It is thought that this plays a role in signalling throughout the plant, and some people even suggest that electrical signals could form the basis of plant memories. We have recently also discovered that tomato plants pass electrical signals to each other through the soil via their roots. This shows the flow of electricity is important to plants. It is harder to see how an external electric field would boost their growth. There is one good reason why it might, at least according to ideas developed in the 1990s by Andrew Goldsworthy, a now-retired plant scientist who worked at Imperial College London. His suggestion was that it would be beneficial for plants to ramp up their growth following a thunderstorm when there is a lot of rain. Rather than the standard 100 volts per metre electrical field gradient in the atmosphere, a storm can produce a gradient of several hundred volts per metre or more. Goldsworthy reasoned that plants might have evolved to sense the change in field. He conducted experiments with tobacco plants in 1991 in which he showed that applying a weak external field changed the pattern of calcium ion currents in the plants. He reckoned this might be how they sensed electric fields. If he was right, it might explain why the electroculture experiments in the early 20th century was so mixed. The plants would have taken the applied electric fields as a signal of impending rain, and when it didn't come, that might have affected them negatively. Still, this is all conjecture. Biophysicist Ellard Hunting at the University of Bristol, UK, says there is no detailed understanding of how growth might be enhanced by electric fields. "The mechanisms that underpin these observations remain largely elusive," he says. "But there is definitely a very interesting interaction between plants and their electrical environment – time will tell how this might actually benefit agriculture." Jean Yong at the Swedish University of Agricultural Sciences in Uppsala takes a more optimistic view. "In a nutshell, plants do respond to electrical fields," he says. It is logical, he says, that an electric field could speed up the flow of crucial nutrient ions like nitrate or calcium. "But there is no concrete or published data to prove the phenomenon." Although economics did for electroculture in the early 20th century, electricity is now far cheaper and less polluting. Yet even with that stumbling block removed, there are plenty of other ways to boost crop yields, from adding more fertiliser to increasing the carbon dioxide in greenhouses. How electroculture compares is unclear for the moment. If it does turn out to be a good option, the evidence might well come from

Gossip

CHEMWATCH

those greenhouses scattered across China, where the charged air quietly hums above the greenery.

New Scientist, 21 August 2019

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

Stealth glider made out of special polymer self-destructs in sunlight

2019-08-27

Spies and soldiers might soon be able to go behind enemy lines using a parachute or glider made from a polymer that vanishes on exposure to sunlight. "This started off with building small sensors for the government — microphones, cameras, things that detect metal," says Paul Kohl at the Georgia Institute of Technology, who presented the work at a meeting of the American Chemical Society in California this week. The idea was that these sensors could be spread across a battlefield, say, and used to collect information for the army. "But you don't want anyone to discover it and take it apart and see how it works," says Kohl. That's why he and his team wanted to invent a self-destructing material. They began with polymers that have a low ceiling temperature, which is the point at which the key bonds holding the substance together begin to break. Lots of polymers break down slowly when they reach this temperature because many bonds have to be broken. But Kohl designed his material so that as soon as one bond breaks the whole thing rapidly unzips. They based their polymer on a chemical called an aldehyde and mixed in other chemical additives that can either make it rigid for use in a glider or sensor, or flexible to make a fabric for a parachute. Sunlight or artificial light can trigger the material to go poof. Or, in true spy style, a small light emitting diode can be placed inside a device to trigger the self-destruct process on demand. All that's left behind is a residue and a faint smell, which Kohl says are from the additives that control the rigidity of the material.

Gliding in the dark

Kohl says he and his team have already made a glider with a six-foot wingspan from the material. It can only carry objects weighing about 1 kilogram, so it could only be used to covertly transport objects, not people, for the moment. The glider would have to travel under cover of darkness to avoid disintegrating in flight. Marek Urban at Clemson University in South Carolina says the chemical reactions involved in the depolymerisation are not novel, but this covert intelligence application

Spies and soldiers might soon be able to go behind enemy lines using a parachute or glider made from a polymer that vanishes on exposure to sunlight.

Gossip

CHEMWATCH

may be. But he says there may be a problem with the residue left behind after the polymer disappears. "My question is, does this system leave you with some monomers you didn't start with? This could be extremely harmful because if you don't know what those monomers are as a result, you could create another problem," says Urban. Kohl says he's tested the residue on plants, which did experience some discoloration but did not die. "If you're out in the wild and it's rocky and certainly in a desert or things like that, there's very little concern about leaving a lot of hazardous materials behind," he says.

New Scientist, 26 August 2019

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

NASA Images Show Just How Much Carbon Monoxide Is Coming Off The Burning Amazon

2019-08-24

A NASA satellite captured harrowing images of carbon monoxide in the atmosphere due to the wildfires that continue to rage in the Amazon rainforest. NASA collected new data from their Atmospheric Infrared Sounder (AIRS) instrument, measuring levels of carbon monoxide at an altitude of 18,000 feet (5,500 meters) from August 8 to 22, according to a press release. The AIRS, which is aboard NASA's Aqua satellite, measures "atmospheric temperature and humidity, cloud amounts and heights, greenhouse gas concentrations and many other atmospheric phenomena," the press release stated. This animation of the new data shows carbon monoxide rising into the atmosphere, indicated by colours green, yellow, and dark red to demonstrate the concentration of the gas by parts per billion by volume (ppbv). "Green indicates concentrations of carbon monoxide at approximately 100 parts per billion by volume (ppbv); yellow, at about 120 ppbv; and dark red, at about 160 ppbv," NASA wrote in the press release. "Local values can be significantly higher." As an air pollutant that can travel long distances and stay in the atmosphere for about a month, carbon monoxide plays a significant role in climate change. While the AIRS evaluated carbon monoxide at a relatively high altitude and has little effect on the air we breathe as of right now, "strong winds can carry it downward to where it can significantly impact air quality," NASA wrote in the press release. Concern for the world's largest rainforest arose as a record number of wildfires blazed through the Amazon this year – a total of 72,843 incidents, according to Brazil's National Institute for Space Research (INPE). The fires were reportedly caused by humans.

A NASA satellite captured harrowing images of carbon monoxide in the atmosphere due to the wildfires that continue to rage in the Amazon rainforest.

Gossip

CHEMWATCH

Brazilian president Jair Bolsonaro has encouraged the development of the rainforest for mining, logging, and farming.

Science Alert, 24 August 2019

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

Physicists Find Evidence of Superconductivity at Temperatures Well Above The Current Threshold

2019-08-27

Scientists have found evidence of superconductivity happening at temperatures and energy levels way above its normal boundaries – a finding which could one day go on to help revolutionise the design and workings of our electronics. A superconductor material is one that can transfer electricity without resistance. In turn, this means the electricity travels through without energy losses, a phenomenon that would be of huge benefit everywhere from the gadgets in our pockets to larger electrical infrastructure. The catch is that superconductors only start superconducting at very low temperatures. To make it practical, scientists and engineers are interested in getting superconductivity happening at room temperature, and this new finding is another step in the right direction. In the new study, researchers have observed Cooper pairs happening where they shouldn't be. A Cooper pair is when electrons snuggle together in pairs, close enough to pass through materials more easily (and without generating heat). The discovery of electron pairing happening above the critical temperature that it normally occurs at won't be "crazy surprising" to the scientific community, according to physicist Doug Natelson from Rice University in Texas – but there's more. "The thing that's more weird is that it looks like there are two different energy scales," says Natelson of the new result. "There's a higher energy scale where the pairs form, and there's a lower energy scale where they all decide to join hands and act collectively and coherently, the behaviour that actually brings about superconductivity." In other words, it looks like Cooper pairs can form at higher temperatures, but don't enter a state of coherence or start moving collectively – which is what creates superconductivity – until the lower temperatures are reached. Scientists have previously hypothesised that this might be the case, but this is the first direct evidence for it, found in a superconductor called lanthanum strontium copper oxide (LSCO). LSCO is a high-temperature superconductor, which works at higher-than-normal temperatures (though still extremely cold, hundreds of degrees below zero degrees Celsius). Instead of just looking at the electrical current, the researchers analysed what's known as shot

Scientists have found evidence of superconductivity happening at temperatures and energy levels way above its normal boundaries – a finding which could one day go on to help revolutionise the design and workings of our electronics.

Gossip

CHEMWATCH

noise: variations in the flow of the electrical charge. Those variations didn't match what would be expected from a flow single electrons, suggesting pairing was happening at higher temperatures than it should be. We're still a long way from room temperature superconductivity, but it appears that in LSCO at least, a high fraction of electrons are pairing up at temperatures well above the usual level needed for superconductivity – and that could be invaluable in future research. The next step is to investigate how that pairing could lead to coherence, and from there to superconductivity. "If that's true, and you've already got pairs at higher temperatures, the question is, 'can you also get coherence at those temperatures?'" says Natelson. "Can you somehow convince [the electrons] to start their dance in the region known as the pseudogap, a phase space at higher temperatures and energy scales than the superconducting phase?" We'll have to wait and see where the research takes us, but it's a pretty cool step. The research has been published in Nature.

Science Alert, 23 August 2019

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

Mosquito incognito: Could graphene-lined clothing help prevent mosquito bites?

2019-08-27

The nanomaterial graphene has received significant attention for its potential uses in everything from solar cells to tennis rackets. But a new study by Brown University researchers finds a surprising new use for the material: preventing mosquito bites. In a paper published in Proceedings of the National Academy of Sciences, researchers showed that multilayer graphene can provide a two-fold defence against mosquito bites. The ultra-thin yet strong material acts as a barrier that mosquitoes are unable to bite through. At the same time, experiments showed that graphene also blocks chemical signals mosquitoes use to sense that a blood meal is near, blunting their urge to bite in the first place. The findings suggest that clothing with a graphene lining could be an effective mosquito barrier, the researchers say. "Mosquitoes are important vectors for disease all over the world, and there's a lot of interest in non-chemical mosquito bite protection," said Robert Hurt, a professor in Brown's School of Engineering and senior author of the paper. "We had been working on fabrics that incorporate graphene as a barrier against toxic chemicals, and we started thinking about what else the approach might be good for. We thought maybe graphene could provide mosquito bite protection as well." To find out if it would work, the researchers recruited some brave

A new study shows that graphene sheets can block the signals mosquitoes use to identify a blood meal, potentially enabling a new chemical-free approach to mosquito bite prevention.

Gossip

CHEMWATCH

participants willing to get a few mosquito bites in the name of science. The participants placed their arms in a mosquito-filled enclosure so that only a small patch of their skin was available to the mosquitoes for biting. The mosquitoes were bred in the lab so they could be confirmed to be disease-free. The researchers compared the number of bites participants received on their bare skin, on skin covered in cheesecloth and on skin covered by a graphene oxide (GO) films sheathed in cheesecloth. GO is a graphene derivative that can be made into films large enough for macro-scale applications. It was readily apparent that graphene was a bite deterrent, the researchers found. When skin was covered by dry GO films, participants didn't get a single bite, while bare and cheesecloth-covered skin was readily feasted upon. What was surprising, the researchers said, was that the mosquitoes completely changed their behaviour in the presence of the graphene-covered arm. "With the graphene, the mosquitoes weren't even landing on the skin patch -- they just didn't seem to care," said Cintia Castilho, a Ph.D. student at Brown and the study's lead author. "We had assumed that graphene would be a physical barrier to biting, through puncture resistance, but when we saw these experiments, we started to think that it was also a chemical barrier that prevents mosquitoes from sensing that someone is there." To confirm the chemical barrier idea, the researchers dabbed some human sweat onto the outside of a graphene barrier. With the chemical cues on the other side of the graphene, the mosquitoes flocked to the patch in much the same way they flocked to bare skin. Other experiments showed that GO can also provide puncture resistance -- but not all the time. Using a tiny needle as a stand-in for a mosquito's proboscis, as well as computer simulations of the bite process, the researchers showed that mosquitoes simply can't generate enough force to puncture GO. But that only applied when the GO is dry. The simulations found that GO would be vulnerable to puncture when it was saturated with water. And sure enough, experiments showed that mosquitoes could bite through wet GO. However, another form of GO with reduced oxygen content (called rGO) was shown to provide a bite barrier when both wet and dry. A next step for the research would be to find a way to stabilize the GO so that it's tougher when wet, Hurt says. That's because GO has a distinct advantage over rGO when it comes to wearable technology. "GO is breathable, meaning you can sweat through it, while rGO isn't," Hurt said. "So, our preferred embodiment of this technology would be to find a way to stabilise GO mechanically so that it remains strong when wet. This next step would give us the full benefits of breathability and bite protection." All told, the researchers say, the study suggests that properly engineered graphene linings could be used to make mosquito protective clothing. Other co-authors on the study were

Gossip

CHEMWATCH

Dong Li, Muchun Liu, Yue Liu and Huajian Gao. The study was funded by the National Science Foundation (CMMI-1634492)

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<http://www.sciencedaily.com>

A new way to make valuable chemicals

2019-08-27

In an effort to develop sustainable solutions to humanity's energy needs, many scientists are studying carbon capture and utilisation -- the practice of using excess carbon dioxide in the atmosphere or from point sources, instead of fossil fuels, to synthesise chemicals used to make everyday products, from plastics to fuels to pharmaceuticals. Feng Jiao, an associate professor of chemical and biomolecular engineering at the University of Delaware, is a leader in the field of carbon capture and utilisation. Now, he and his colleagues have made a new discovery that could further advance carbon capture and utilisation and extend its promise to new industries. In the journal *Nature Chemistry*, Jiao and collaborators from the California Institute of Technology, Nanjing University (China), and Soochow University (China) describe how they formed carbon-nitrogen bonds in an electrochemical carbon monoxide reduction reaction, which led to the production of high-value chemicals called amides. These substances are useful in a variety of industries, including pharmaceuticals. The team is the first to do this. "Now, starting with carbon dioxide as a carbon source, we can expand to a variety of products," said Jiao, the associate director for UD's Centre for Catalytic Science and Technology (CCST).

Ingenuity that began at UD

The science behind these findings is electrochemistry, which utilises electricity to produce chemical change. In previous research efforts, Jiao developed a special silver catalyst, which converts carbon dioxide to carbon monoxide. Next, he wanted to further upgrade carbon monoxide into multi-carbon products useful in the production of fuels, pharmaceuticals and more. "In the field of electrochemical carbon dioxide conversion, we were stuck with only four major products we can make using this technology: ethylene, ethanol, propanol, and, as we reported just a couple months ago in *Nature Catalysis*, acetate," said Jiao. Nitrogen is the secret ingredient to unlock the potential of the system. The team used an electrochemical flow reactor that is typically fed with carbon dioxide or carbon monoxide, but this time they put in both carbon monoxide and ammonia, a compound that contains nitrogen. The nitrogen source

A new discovery has advanced the field of carbon capture and utilisation.

Gossip

CHEMWATCH

interacts with the copper catalyst at the electrode-electrolyte interface, leading to the formation of carbon-nitrogen (CN) bonds. This process allowed the team to synthesise chemicals that had never before been made in this way, including amides, which can be used in pharmaceutical synthesis. Many pharmaceutical compounds contain nitrogen, and "this actually provides a unique way to build large molecules which contains nitrogen from simple carbon and nitrogen species," said Jiao. At a meeting of the American Chemical Society, Jiao shared some of his preliminary findings with William A. Goddard III, principal investigator at the Joint Centre for Artificial Photosynthesis at Caltech. Goddard, a world-leading expert who uses Quantum Mechanics to determine reaction mechanism and rates of such electrocatalytic processes, was very excited about this unexpected discovery and immediately set his team. Tao Cheng in the Goddard lab found that the new carbon-nitrogen bond coupling was an off-shoot of the mechanism that had been determined for the production of ethylene and ethanol, suggesting that Jiao might be able couple bonds other than CN. "Through a close collaboration with Prof. Goddard, we learned quite a lot in terms of how this carbon-nitrogen bond formed on the surface of the catalyst," said Jiao. "This gave us important insights on how we can design even better catalysts to facilitate some of these kinds of chemical reactions." The implications of this work could be far-ranging. "This has the significant impact down the road, I think, to partially address carbon dioxide emission issues," said Jiao. "Now we can actually utilise it as the carbon feedstock to produce high-value chemicals."

Science Daily, 26 August 2019

<http://www.sciencedaily.com>

Chemists discover water microdroplets spontaneously produce hydrogen peroxide

2019-08-27

Water is everywhere on Earth, but maybe that just gives it more space to hide its secrets. Its latest surprise, Stanford researchers report Aug. 26 in Proceedings of the National Academy of Sciences, is that microscopic droplets of water spontaneously produce hydrogen peroxide. The discovery could pave the way for greener ways to produce the molecule, a common bleaching agent and disinfectant, said Richard Zare, the Marguerite Blake Wilbur Professor in Natural Science and a professor of chemistry in the Stanford School of Humanities and Sciences. "Water is one of the most commonly found materials, and it's been studied for years and years and you would think that there was nothing more to learn about

Richard Zare and his lab have shown that water microdroplets spontaneously - and unexpectedly - produce hydrogen peroxide.

Gossip

CHEMWATCH

this molecule. But here's yet another surprise," said Zare, who is also a member of Stanford Bio-X. The discovery was made serendipitously while Zare and his lab were studying a new, more efficient way to create gold nanostructures in tiny water droplets known as microdroplets. To make those structures, the team added an additional molecule called a reducing agent. As a control test, Zare suggested seeing if they could create gold nanostructures without the reducing agent. Theoretically that should have been impossible, but it worked anyway—hinting at an as yet undiscovered feature of microdroplet chemistry. The team eventually traced those results to the presence of a molecule called hydroxyl—a single hydrogen atom paired with an oxygen atom—that can also act as a reducing agent. That equally unexpected result led Katherine Walker, at the time a graduate student in Zare's lab, to wonder whether hydrogen peroxide—a molecule with two hydrogen and two oxygen atoms—was also present. To find out, Zare, Walker, staff scientist Jae Kyoo Lee and colleagues conducted a series of tests, the simplest of which involved spraying ostensibly pure water microdroplets onto a surface treated so that it would turn blue in the presence of hydrogen peroxide—and turn blue it did. Additional tests confirmed that water microdroplets spontaneously form hydrogen peroxide, that smaller microdroplets produced higher concentrations of the molecule, and that hydrogen peroxide was not lost when the microdroplets recombined into bulk water. The researchers ruled out a number of possible explanations before arriving at what they argue is the most likely explanation for hydrogen peroxide's presence. They suggest that a strong electric field near the surface of water microdroplets in air triggers hydroxyl molecules to bind into hydrogen peroxide. Although the results are something of a basic science curiosity, Zare said, they could have important practical consequences. Hydrogen peroxide is an important commercial and industrial chemical, most often manufactured through an ecologically unfriendly process. The new discovery could help make those methods greener, Zare said, and it could lead to simpler ways to disinfect surfaces—simply spraying water microdroplets on a table or floor might be enough to clean it. "I think it could be one of the most important things I've ever done," Zare said.

Phys.org, 26 August 2019

<http://phys.org>

Tiny tweaks for big wins in solar cells

2019-08-27

Solar cell performance and stability depend on the morphology of the thin films, especially their ability to crystallize in the so-called photoactive α -phase. Perovskites containing lead tend to combine various halides, such as the anionic forms of bromine and iodine, with mixtures of methylammonium, formamidinium, caesium and other cations. These have led to record conversion efficiencies and thermal stabilities compared with their single-halide, single-cation analogues. However, these mixed-halide, mixed-cation perovskite films have been characterized only through ex-situ post-deposition techniques. This limits the understanding of the mechanisms that govern their growth from their sol-gel precursor to their solid state and stalls attempts to improve device performance and stability. Now, Stefaan De Wolf, his postdoc Kai Wang and co-workers have investigated the impact of cations, halides and antisolvent dripping on mixed-halide, mixed-cation perovskite films. The team tracked the films' structural evolution during the spin-coating deposition process using in situ X-ray scattering technique. The X-ray technique probed the films at the atomic scale from their sol-gel precursor to the solid state and provided information about the formation of crystalline intermediates during the solidification. The researchers also incorporated the films into solar cells and evaluated the performance and stability of the resulting devices. "Our study provides critical insights into the crystallisation of the multicomponent systems toward high-performance perovskite solar cells," Wang says. Changes in the compositions of the halide and cation dramatically affected the solidification of the perovskite precursors during spin coating and the subsequent formation of the desired α -phase upon antisolvent addition. The period needed to generate high-quality films by antisolvent addition ended when the sol-gel structure collapsed to produce crystalline by-products depending on the precursor mixture. Consequently, tuning the halide-cation mixture could delay this collapse, widening the antisolvent dripping window from a few seconds to several minutes. As well, simultaneously incorporating caesium and rubidium cations in the perovskite synergistically stimulated the formation of the α -phase. The length of this window showed little effect on resulting solar cell performance as long as the antisolvent was added within this period. These findings suggest new directions for the development of perovskite formulations that can further stabilise the sol-gel state and promote its conversion to the desirable perovskite phase. "This is critical in achieving better-performing, reproducible, cost-efficient and scalable manufacturing of perovskite solar cells," Wang says. The team is working on transferring

Solar cell performance and stability depend on the morphology of the thin films, especially their ability to crystallize in the so-called photoactive α -phase.

Gossip

CHEMWATCH

this knowledge to other deposition technologies to progress toward market-ready perovskite solar cells.

Tech Xplore, 26 August 2019

<https://techxplore.com/>

New coating brings lithium metal battery closer to reality

2019-08-27

Hope has been restored for the rechargeable lithium metal battery—a potential battery powerhouse relegated for decades to the laboratory by its short life expectancy and occasional fiery demise while its rechargeable sibling, the lithium-ion battery, now rakes in more than \$30 billion a year. A team of researchers at Stanford University and SLAC National Accelerator Laboratory has invented a coating that overcomes some of the battery's defects, described in a paper published Aug. 26 in *Joule*. In laboratory tests, the coating significantly extended the battery's life. It also dealt with the combustion issue by greatly limiting the tiny needle-like structures—or dendrites—that pierce the separator between the battery's positive and negative sides. In addition to ruining the battery, dendrites can create a short circuit within the battery's flammable liquid. Lithium-ion batteries occasionally have the same problem, but dendrites have been a non-starter for lithium metal rechargeable batteries to date. "We're addressing the holy grail of lithium metal batteries," said Zhenan Bao, a professor of chemical engineering, who is senior author of the paper along with Yi Cui, professor of materials science and engineering and of photon science at SLAC. Bao added that dendrites had prevented lithium metal batteries from being used in what may be the next generation of electric vehicles.

The promise

Lithium metal batteries can hold at least a third more power per pound as lithium-ion batteries do and are significantly lighter because they use lightweight lithium for the positively charged end rather than heavier graphite. If they were more reliable, these batteries could benefit portable electronics from notebook computers to cell phones, but the real pay dirt, Cui said, would be for cars. The biggest drag on electric vehicles is that their batteries spend about a fourth of their energy carrying themselves around. That gets to the heart of EV range and cost. "The capacity of conventional lithium-ion batteries has been developed almost as far as it can go," said Stanford Ph.D. student David Mackanic, co-lead author of

A new coating could make lightweight lithium metal batteries safe and long lasting, a boon for development of next-generation electric vehicles.

Gossip

CHEMWATCH

the study. "So, it's crucial to develop new kinds of batteries to fulfil the aggressive energy density requirements of modern electronic devices." The team from Stanford and SLAC tested their coating on the positively charged end—called the anode—of a standard lithium metal battery, which is where dendrites typically form. Ultimately, they combined their specially coated anodes with other commercially available components to create a fully operational battery. After 160 cycles, their lithium metal cells still delivered 85 percent of the power that they did in their first cycle. Regular lithium metal cells deliver about 30 percent after that many cycles, rendering them nearly useless even if they don't explode. The new coating prevents dendrites from forming by creating a network of molecules that deliver charged lithium ions to the electrode uniformly. It prevents unwanted chemical reactions typical for these batteries and also reduces a chemical build-up on the anode, which quickly devastates the battery's ability to deliver power. "Our new coating design makes lithium metal batteries stable and promising for further development," said the other co-lead author, Stanford Ph.D. student Zhiao Yu. The group is now refining their coating design to increase capacity retention and testing cells over more cycles. "While use in electric vehicles may be the ultimate goal," said Cui, "commercialisation would likely start with consumer electronics to demonstrate the battery's safety first."

Phys.org, 26 August 2019

<http://phys.org>

3-D printed salt template for bioresorbable bone implants

2019-08-27

With the help of a 3-D printed salt template, ETH researchers have succeeded in producing magnesium scaffolds with structured porosity that are suitable for bioresorbable bone implants. For the treatment of complex bone fractures or even missing bone parts, surgeons typically deploy metal implants. In this context, an attractive alternative to the traditional materials like bioinert titanium are biodegradable magnesium and its alloys. Implants made of the latter light metal are advantageous because they can biodegrade in the body, which can absorb magnesium as a mineral nutrient, rendering a second surgery for implant removal unnecessary. To promote rapid healing, the design of implants or their surfaces should be directed towards promotion of cellular adhesion or even in-growth. Materials researchers from the Laboratory of Metal Physics and Technology and the Complex Materials Group at ETH Zurich have

With the help of a 3-D printed salt template, ETH researchers have succeeded in producing magnesium scaffolds with structured porosity that are suitable for bioresorbable bone implants.

Gossip

CHEMWATCH

therefore collaborated to develop a new procedure for the manufacture of magnesium implants that contain numerous structurally ordered pores but still retain their mechanical stability. This development is the subject of a forthcoming article in *Advanced Materials*.

Scaffolds made of magnesium

To create a porous structure the researchers first printed a three-dimensional salt template using a 3-D printer. Because pure, standard table salt is not suitable for printing, they developed a gel-like salt paste for this purpose. The strut diameters and spacings of the salt template can be tailored by the printing process. To gain sufficient mechanical strength the salt structure was subsequently sintered. During sintering the fine-grained materials are heated significantly, while the temperature is chosen safely below the paste's melting point to retain the structure of the workpiece.

The next step was to infiltrate the pores with magnesium melt. "The infiltrates obtained in this way are mechanically very stable and can be easily polished, turned and shaped," says Jörg Löffler, Professor of Metal Physics and Technology in the Department of Materials. After mechanical shaping the researchers dissolved the salt, leaving a pure magnesium implant with numerous, regularly structured pores.

Decisive for clinical success

"The possibility to control the pore size, distribution and orientation in the material is decisive for clinical success, because bone cells like to grow into these pores," says Löffler. Growth into pores is in turn decisive for the rapid integration of the implant in bone. The new procedure for manufacturing these template structures from salt can be applied to other materials besides magnesium. Co-authors Martina Cihova and Dr. Kunal Masania expect that the process can also be used to tailor pore geometries in polymers, ceramics and other light metals. The idea of this new manufacturing procedure emerged within the framework of the Master's thesis of Nicole Kleger, whose study was supported by an ETH Zurich Excellence Scholarship & Opportunity stipend. Her work was also awarded with the ETH medal for excellent Master's theses. Nicole Kleger is now a doctoral student in the Complex Materials Group of ETH professor André Studart, under whose direction the initial salt template was 3-D printed.

Gossip

CHEMWATCH

In her doctoral thesis project Kleger is now developing the 3-D-printing procedure further.

Phys.org, 26 August 2019

<http://phys.org>

Can't get thinner than this: Synthesis of atomically flat boron sheets

2019-08-27

Since its rediscovery and characterisation in 2004, graphene has been the focus of countless research efforts across multiple fields. It is a very versatile material consisting of a two-dimensional (2D) carbon network; in other words, it comprises a thin sheet of carbon that has a thickness of one atom. Graphene is not only stronger than the strongest steels, but also has a myriad of interesting chemical, electronic, and mechanical characteristics that has left scientists wondering if similar 2D networks of other materials could have such useful properties. One novel 2D material that was recently reported is borophene, an analogue of graphene but consisting of boron atoms instead of carbon atoms. However, as one would expect for 2D sheets of any material, the synthesis of borophene has proved to be challenging. Researchers either require the use of a substrate to make borophene more stable or coupling boron with hydroxyl groups (OH-), which causes the structure to not be atomically flat. In a recent study conducted at Tokyo Institute of Technology, a research team including Tetsuya Kambe, Akiyoshi Kuzume and Kimihisa Yamamoto was successful in synthesising atomically flat oxidized borophene sheets through a simple solution-based method. First, they synthesized stacked layers of borophene oxide through a fairly simple process using a potassium borohydride salt (KBH₄). An X-ray analysis revealed the 2D-layered structure of the material, in which layers of boron atoms forming a hexagonal 2D network with oxygen atoms as bridges were intercalated with layers containing potassium atoms. Then, the subsequent necessary step was to find a way to exfoliate atomically thin layers of the borophene oxide network. The researchers achieved this by putting the material in dimethylformamide, which is a commonly used organic solvent. Various types of measurements were carried out to verify the structure of the exfoliated sheets, including electron microscopy, spectroscopy, and atomic force microscopy. The results confirmed that the proposed method was effective for producing the desired atomically flat oxidized borophene sheets. Finally, the researchers performed resistivity measurements to analyse the conducting properties of stacked borophene sheets and

Scientists have found a simple method for producing atomically thin layers of oxidised borophene, a promising 2D boron-based nanomaterial that could serve in a variety of fields.

Gossip

CHEMWATCH

found an interesting characteristic referred to as anisotropy. This means that the sheets exhibited different types of conductivity depending on the direction of the current flow. The material behaved like a semiconductor in the inter-plane direction, whereas it exhibited metal-like behaviour in the in-plane direction of the boron network. The mechanisms behind these two types of conducting behaviours were elucidated as well. "It is important to note that our boron sheets can be handled easily at ambient conditions," remarks Dr. Kambe, indicating that this pioneering research could be the basis for finding potential applications for borophene. Finding facile methods for the synthesis of borophene and borophene-based compounds is crucial to conducting further research on this interesting material and its potential uses. "Like graphene, borophene is expected to have unique properties, including extraordinary mechanical characteristics and metallic behaviour that could be exploited in a variety of fields," states Dr. Kambe. Hopefully, future findings and developments on 2D materials will enable us to employ their exotic properties and tailor them to suit our needs.

Science Daily, 23 August 2019

<http://www.sciencedaily.com>

New rechargeable aqueous battery challenges Lithium-ion dominance

2019-08-27

A new rechargeable high voltage manganese dioxide zinc battery, exceeding the 2 V barrier in aqueous zinc chemistry, is the latest invention by City College of New York researchers. With a voltage of 2.45-2.8V, the alkaline MnO₂|Zn battery, developed by Dr. Gautam G. Yadav and his group in the CCNY-based CUNY Energy Institute, could break the long dominance of flammable and expensive lithium (Li)-ion batteries in the market. To break the previously daunting 2 V barrier in aqueous zinc chemistry, primary inventor Yadav and his team interfacially engineered two different aqueous electrolytes that deliver the theoretical capacity (308mAh/g) reversibly for many cycles. "The voltage of current commercially available alkaline MnO₂|Zn batteries is around 1.2-1.3V, and this has been considered low compared to Li-ion which has a voltage >3V," said Yadav. Voltage has been Li-ion's greatest asset and has helped fuel its rise in an energy hungry world. "Unfortunately, it contains elements that are toxic and geopolitically sensitive with Asian countries having a monopoly on mining and manufacturing them," added Yadav. "This has put the United States at a tremendous disadvantage and has lost its lead

A new rechargeable high voltage manganese dioxide zinc battery exceeds the 2 V barrier in aqueous zinc chemistry. With a voltage of 2.45-2.8V, the alkaline MnO₂|Zn battery could break the long dominance of flammable and expensive lithium (Li)-ion batteries in the market.

Gossip

CHEMWATCH

in energy storage industry, when in the past it was a world leader. With Mn and Zn being widely available elements, and with the U.S. being rich with them as well, it allows the U.S. to compete again. The manufacturing cost of these batteries will also be low, so it can kick start the growth of the energy storage industry in the U.S.”

Science Daily, 20 August 2019

<http://www.sciencedaily.com>

Producing protein batteries for safer, environmentally friendly power storage

2019-08-27

Proteins are good for building muscle, but their building blocks also might be helpful for building sustainable organic batteries that could someday be a viable substitute for conventional lithium-ion batteries, without their safety and environmental concerns. By using synthetic polypeptides—which make up proteins—and other polymers, researchers have taken the first steps toward constructing electrodes for such power sources. The work could also provide a new understanding of electron-transfer mechanisms. The researchers will present their results today at the American Chemical Society (ACS) Fall 2019 National Meeting & Exposition. “The trend in the battery field right now is to look at how the electrons are transported within a polymer network,” says Tan Nguyen, a Ph.D. student who helped develop the project. “The beauty of polypeptides is that we can control the chemistry on their side chains in 3-D without changing the geometry of the backbone, or the main part of the structure. Then we can systematically examine the effect of changing different aspects of the side chains.” Current lithium-ion batteries can harm the environment, and because the cost of recycling them is higher than manufacturing them from scratch, they often accumulate in landfills. At the moment, there is no safe way of disposing of them. Developing a protein-based, or organic, battery would change this situation. “The amide bonds along the peptide backbone are pretty stable—so the durability is there, and we can then trigger when they break down for recycling,” says Karen Wooley, Ph.D., who leads the team at Texas A&M University. She envisions that polypeptides could eventually be used in applications such as flow batteries for storing electrical energy. “The other advantage is that by using this protein-like architecture, we’re building in the kinds of conformations that are found in proteins in nature that already transport electrons efficiently,” Wooley says. “We can also optimise this to control battery performance.” The researchers built the system using electrodes made of composites of

Proteins are good for building muscle, but their building blocks also might be helpful for building sustainable organic batteries that could someday be a viable substitute for conventional lithium-ion batteries, without their safety and environmental concerns.

Gossip

CHEMWATCH

carbon black, constructing polypeptides that contain either viologen or 2,2,6,6-tetramethylpiperidine 1-oxyl (TEMPO). They attached viologens to the matrix used for the anode, which is the negative electrode, and used a TEMPO-containing polypeptide for the cathode, which is the positive electrode. The viologens and TEMPO are redox-active molecules. "What we've measured so far for the range, the potential window between the two materials, is about 1.5 volts, suitable for low-energy requirement applications, such as biosensors," Nguyen says. For potential use in an organic battery, Nguyen has synthesised several polymers that adopt different conformations, such as a random coil, an alpha helix and a beta sheet, to investigate their electrochemical characteristics. With these peptides in hand, Nguyen is now collaborating with Alexandra Danielle Easley, a Ph.D. student in the laboratory of Jodie Lutkenhaus, Ph.D., also at Texas A&M University, to build the battery prototypes. Part of that work will include testing to better understand how the polymers function when they're organised on a substrate. While this early stage research has far to go before organic-based batteries are commercially available, the flexibility and variety of structures that proteins can provide promise wide potential for sustainable energy storage that is safer for the environment.

Phys.org, 26 August 2019

<http://phys.org>

Curiosities

CHEMWATCH

Genetic studies suggest alcohol isn't linked to breast cancer after all

2019-08-28

Could the health risks from booze be overblown? A new study has found that low levels of alcohol do not cause cancer, and even heavy drinking doesn't cause breast cancer – contrary to official UK warnings. The question of how much alcohol it is safe to drink has long been debated. Heavy drinkers are definitely more prone to mouth and throat cancers, and cirrhosis, where the liver starts failing, but it was long thought that light drinking was safe or possibly even good for you. A growing number of studies, though, have suggested that even low levels of alcohol are linked with a higher risk of cancer, including that of the breast, oesophagus and colon. In 2016, the UK tightened up its alcohol guidelines, cutting the maximum that men should drink from 21 units a week to 14, with the limit for women staying at 14 – equivalent to six pints of beer or just under one and a half bottles of wine. At the time, the UK's chief medical officer, Dame Sally Davies, warned there was "no safe level of drinking" and said whenever women had a glass of wine, they should weigh up whether it was worth the raised risk of breast cancer. But the studies that showed these risks from light drinking have a weakness in that they simply look at correlations between drinking levels and cancer rates, and so cannot tell us if alcohol is the cause. Something else could be responsible, as people who drink more also tend to smoke more, have lower incomes, and have unhealthy lifestyles in various other ways. In the latest work, which has not yet been published, Fotios Drenos and colleagues of Brunel University London in the UK got around this problem by analysing genes, which are determined at conception and can't be affected by lifestyle influences, like whether someone smokes. They focussed on a gene variant of an enzyme made in the liver that leaves people feeling sick and dizzy after relatively little alcohol. People can have either two, one or no copies of this variant, and those with more copies unsurprisingly tend to drink less. Drenos's team looked at about 300,000 people taking part in a large UK study called Biobank, which has sequenced people's genes and periodically surveys their health and behaviour; it has now tracked participants for up to 13 years. Women who were genetically predisposed to drink more, because of a lower amount of this liver enzyme, didn't have a higher rate of breast cancer. In fact, there was no correlation between genes and the likelihood of any type of cancer studied when looking at those who drink less than 14 units a week. However, the team did not study every type of cancer, only breast cancer in women and tumours of the mouth, throat and the rest of the digestive system. In people who went over this threshold,

A new study has found that low levels of alcohol do not cause cancer.

Curiosities

CHEMWATCH

though, those genetically predisposed to drink more did have a higher rate of throat cancer. "It's more biologically plausible that heavy drinking causes these tumours as alcohol comes into contact with the throat," says Drenos. The team also confirmed the lack of a link with breast tumours in another pre-existing study of genes and cancer, called COGS. But Frank Dudbridge of the University of Leicester in the UK, who was not involved in the work, says the findings aren't the final word, because the cancer risks could be too low to be revealed this way. "It's difficult to find a small effect unless you have really big datasets." And Emmert Roberts of King's College London points out that drinking can cause other harms than cancer. "Physically, alcohol can affect pretty much every bodily system. Even at low levels, some people might have an increased risk of depression and anxiety."

New Scientist, 17 August 2019

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

Have we found the true cause of diabetes, stroke and Alzheimer's?

2019-08-28

For decades, health experts have been lecturing us about our bad habits, blaming them for the surge in "lifestyle diseases". These often come on as we age and include heart disease, Alzheimer's, type 2 diabetes and some cancers. Worldwide, 70 per cent of all deaths are now attributed to these conditions. In the UK, it is a whopping 90 per cent. Too much red meat, too little fruit and veg, smoking, drinking, obesity and not enough exercise appear to make all these diseases more likely – and having any of them makes getting the others more likely. But no one really knows why, and we still haven't worked out what causes any of them. Alzheimer's is now one of the UK's biggest killers, yet the main hypothesis for how it originates imploded this year after drugs based on it repeatedly failed. High blood cholesterol is blamed for heart attacks, except most people who have heart attacks don't have it. What we do know is that these conditions usually start causing symptoms later in life, and their prevalence is skyrocketing as we live longer. They all turn inflammation, the method our immune system uses to kill invaders, against us. And, by definition, these diseases aren't communicable. They are down to bad habits and unlucky genes, not germs. Right? Not necessarily. In disease after disease, we are finding that bacteria are covertly involved, invading organs, co-opting our immune systems to boost their own survival and slowly making bits of us break down. The implication is that we may eventually be able to defeat

The diseases most people die of have been attributed to unhealthy lifestyles. But evidence now suggests bacteria are to blame, heralding a revolution in medicine

Curiosities

CHEMWATCH

heart attacks or Alzheimer's just by stopping these microbes. Until now, bacteria's involvement completely eluded us. That's because they tend to work very slowly, stay dormant for long periods or hide inside cells. That makes them difficult to grow in culture, once the gold standard for linking bacteria to disease. But now DNA sequencing has revealed bacteria in places they were never supposed to be, manipulating inflammation in just the ways observed in these diseases. The findings are so contrary to received wisdom and emerging in so many diseases, each with its own separate research community, that awareness of all this is only starting to hit the mainstream. And predictably, as with any paradigm shift, there is resistance. But some researchers, frustrated by years of failure to find causes, and therefore real treatments, for the diseases of ageing, are cautiously excited. And with reason: this could change everything. The worst culprits, which seem to play a role in the widest range of ailments, are the bacteria that cause gum disease. This is the most widespread disease of ageing – in fact, "the most prevalent disease of mankind", says Maurizio Tonetti at the University of Hong Kong. In the US, 42 per cent of those aged 30 or above have gum disease, but that rises to 60 per cent in those 65 and older. It has been measured at 88 per cent in Germany. Strikingly, many of the afflictions of ageing – from rheumatoid arthritis to Parkinson's – are more likely, more severe, or both, in people with gum disease. It is possible that some third thing goes wrong, leading to both gum disease and the other maladies. But there is increasing evidence that the relationship is direct: the bacteria behind gum disease help cause the others. Circumstantial evidence is certainly damning. In the US, states that put federal Medicaid funds towards people's dental costs, including those related to preventing or treating gum disease, ultimately pay between 31 and 67 per cent less than states that don't, to help those people later with heart attacks, diabetes, strokes and cancer. Private insurance companies report similar patterns, says David Ojcius at the University of the Pacific in San Francisco. But how can the bacteria that cause gum disease play a role in all these conditions? To answer that, we have to look at how they turn the immune system against us. Your mouth hosts more than 1000 species of bacteria, in a stable community where potential bad actors are kept in check by peaceful bacteria around them. Elsewhere in the body, including on the skin or the lining of the gut, communities of bacteria live on a continuous sheet of cells, where the outermost layer is constantly shed, getting rid of invasive bacteria. But your teeth can't cast off a layer like that, says Tonetti. There, the bacteria live on a hard surface, which pierces through the protective outer sheet of cells. When the plaque the bacteria on your teeth live in builds up enough to harden and spread under the gum, it triggers inflammation: immune cells flood in and destroy both

Curiosities

CHEMWATCH

microbes and our own infected cells. If this goes on too long, an oxygen-poor pocket develops between gum and tooth. A handful of bacteria take advantage of this and multiply. One of them, *Porphyromonas gingivalis*, is especially insidious, disrupting the stable bacterial community and prolonging inflammation. This might seem a strange thing to do. Most pathogens try to block or avoid inflammation, which normally kills them before it shuts down again. Starting in our 30s and 40s, this shutdown begins failing, leading to the chronic inflammation involved in diseases of ageing. No one knows why. *P. gingivalis* may have a hand in it. It actually perpetuates inflammation by producing molecules that block some inflammatory processes, but not all of them, says Caroline Genco of Tufts University in Massachusetts. The resulting weakened inflammation never quite destroys the bacteria, but keeps trying, killing your own cells in the process. The debris is a feast for *P. gingivalis*, which, unlike most bacteria, needs to eat protein. The destruction also liberates the iron that bacteria need and which the body therefore normally keeps locked up. "These bacteria manipulate their interaction with the host immune response to enhance their own survival," says George Hajishengallis at the University of Pennsylvania.

Gum control

Eventually, the infected tooth falls out – but long before that *P. gingivalis* escapes into the bloodstream. There your immune system makes antibodies against it, which usually defend us from germs. But *P. gingivalis* antibodies seem to be more a mark of its passing than protection. People with these antibodies are actually more likely to die in the next decade than those with none, and more likely to get rheumatoid arthritis or have a heart attack or stroke. This could be because, once in the blood, *P. gingivalis* changes its surface proteins so it can hide inside white blood cells of the immune system, says Genco. It also enters cells lining arteries. It remains dormant in these locations, occasionally waking to invade a new cell, but otherwise remaining hidden from antibiotics and immune defences. However, even hunkered down within our cells, *P. gingivalis* continues to activate or block different immune signals, even changing a blood cell's gene expression to make it migrate to other sites of inflammation, where the bacteria can hop out and feast again. One explanation for why gum disease makes you more likely to get conditions like diabetes and Alzheimer's disease is that it adds to your general "inflammatory load". But *P. gingivalis* may act more directly too: the bacteria have been detected in inflamed tissue in the brain, aorta, heart,

Curiosities

CHEMWATCH

liver, spleen, kidneys, joints and pancreas in mice and, in many cases, humans.

Master of concealment

If the bacterium *Porphyromonas gingivalis* is partly to blame for a wide range of inflammatory diseases such as Alzheimer's and heart disease, why not just kill it? Unfortunately, it is brilliant at dodging our defences: lurking inside cells where antibodies can't reach it, and often lying dormant, making it invisible to antibiotics, which mostly attack bacteria as they divide. We could vaccinate against *P. gingivalis*, but vaccines work by inducing antibodies. People with gum disease already make antibodies against the bacteria, but these seem to do little to stop it. It may be better to have the antibodies early and stop *P. gingivalis* invading our mouths when we are young. Eric Reynolds at the University of Melbourne is running a clinical trial of a vaccine that targets gingipains, the protein-digesting enzymes that *P. gingivalis* makes. Caroline Genco of Tufts University in Massachusetts is also working on an anti-gingipain vaccine. "The key is to prevent it ever colonising," she says. The trouble is, many of us already host the bacteria. Routine gum abrasion, through eating or brushing your teeth, can release the microbes into your bloodstream, even if you don't have gum disease. There it can spread throughout the body and promote inflammation. In studies by the company Cortexyme, antibiotics killed *P. gingivalis* in mice, but it rapidly became resistant. To limit resistance, instead of trying to kill the bacteria, it may be better to block its ability to cause disease. Cortexyme has a drug that does this by blocking gingipains. In mice, it reversed Alzheimer's-like brain damage without driving resistance in *P. gingivalis*, and in a small trial in humans, it improved inflammation and some measures of cognition. A large trial is now under way. But as all these diseases involve inflammation, why not just block that? If we did, it could leave you open to the germs that this immune response does fight off or block other vital things that immune signals do. That's why some companies are working on drugs to block only specific inflammatory signals. But tampering with our complex immune systems without doing damage – as *P. gingivalis* shows – will be a significant challenge. The strongest case against *P. gingivalis* is as a cause of Alzheimer's disease. This constitutes more than two-thirds of all dementia, now the fifth largest cause of death worldwide. It was long blamed on the build-up of two brain proteins, amyloid and tau. But that hypothesis is crumbling: people with dementia may lack this build-up, while people with lots of the proteins may have no dementia – and most damningly, no treatments reducing either have improved symptoms.

Curiosities

CHEMWATCH

Then, in January, teams at eight universities and the San Francisco company Cortexyme found a protein-digesting enzyme called gingipain, produced only by *P. gingivalis*, in 99 per cent of brain samples from people who died with Alzheimer's, at levels corresponding to the severity of the condition. They also found the bacteria in spinal fluid. Giving mice the bacteria caused symptoms of Alzheimer's, and blocking gingipains reversed the damage. Moreover, half of the brain samples from people without Alzheimer's also had gingipain and amyloid, but at lower levels. That is as you would expect if *P. gingivalis* causes Alzheimer's, because damage can accumulate for 20 years before symptoms start. People who develop symptoms may be those who accumulate enough gingipain damage during their lifetimes, says Casey Lynch at Cortexyme. Still, dementia researchers have questioned how a bacterial cause can account for genetic risk factors for Alzheimer's. But it may actually explain them, according to a team in Sweden. The people with the highest genetic risk produce a particular form of an immune protein called ApoE that is destroyed in the disease. Last year, Swedish researchers discovered that gingipains are better at destroying that particular ApoE than other forms. *P. gingivalis* may literally break our hearts too. There is growing evidence for a causal link to atherosclerosis, or "hardening of the arteries". Researchers have found *P. gingivalis* in the fatty deposits that line arterial walls and cause blood clots. When bits of clots clog blood vessels in hearts or brains, they cause heart attack and stroke. The bacteria trigger the molecular changes in artery linings that are typical of atherosclerosis, says Genco. We have also found that *P. gingivalis* creates the lipoproteins thought to trigger atherosclerosis, causes it in pigs and affects arteries much like high fat diets. Lakshmya Kesavalu at the University of Florida, who has cultured viable *P. gingivalis* from the atherosclerotic aortas of mice, calls the bacteria "causal".

The American Heart Association agrees that gum disease is an "independent" risk factor for cardiovascular disease, but doesn't call it causal. It argues that although treating gum disease improves hardened arteries, no studies have found that it reduces heart attacks or strokes. But, according to Steve Dominy at Cortexyme, that could be because, while gum treatment helps arteries by easing inflammatory load, it doesn't eradicate the *P. gingivalis* already in the blood vessels. Clinical trials are needed to firm up the connection, but these are expensive and difficult – especially when the bacterial hypothesis is still in its early days. The link is clearer for type 2 diabetes, in which people lose sensitivity to insulin and eventually can't make enough to control blood sugar. It is currently a pandemic, blamed on the usual lifestyle suspects. Diabetes worsens

Curiosities

CHEMWATCH

gum disease, because high blood sugar levels hurt immune cells. But gum disease also worsens diabetes, and treating it helps as much as adding a second drug to the regimen taken by someone with the condition, according to the American Academy of Periodontology. Treatment is now recommended by diabetes associations, yet none of them list gum disease as a risk factor. As with other conditions, there is evidence that *P. gingivalis* isn't promoting diabetes just by adding to the body's inflammatory load, but may also be acting directly in the liver and pancreas to cut insulin sensitivity. "It is very hard to prove causation in a complex disease," says Genco. We know that mice given a mouthful of *P. gingivalis* get gum disease – and diabetes, rheumatoid arthritis, atherosclerosis, fatty liver disease and Alzheimer's-like symptoms. We know that, in humans, gum disease makes the other diseases more likely, and that *P. gingivalis* lurks in the affected tissues and makes the precise cellular changes typical of these conditions. If these diseases actually share a more direct cause, it might finally suggest cures– as well as explaining just how the same bad habits bring them all on. People who drink more alcohol tend to have more *P. gingivalis* and are more susceptible to gum disease. Tobacco smoke helps the bacteria to invade gum cells. Exercise, the only known way to lower your risk of Alzheimer's, improves gum disease by damping inflammation and ending *P. gingivalis*'s feast. Then there is diet. Douglas Kell at the University of Manchester, UK, believes our blood contains many dormant bacteria, needing only a dose of free iron to awaken and cause disease. That could be why eating too much red meat and sugar or too little fruit and veg lead to these diseases: all increase your blood iron.

The long haul

No official medical advice for warding off these diseases includes "see your dentist", at least not yet. "Periodontal disease should be better recognised by the community as a clearly established risk factor," says Dominy. One of the clearest risks is for Alzheimer's. But guidelines for avoiding Alzheimer's published in May by the World Health Organization (WHO) say nothing about preventing gum disease. "There is insufficient evidence to suggest that treating gum disease reduces the risk of dementia," says Benoit Varenne at the WHO, echoing the verdict on heart disease, even though the same caveats probably apply. The guidelines recommend avoiding diabetes and high blood pressure, despite stating that there is little or no evidence that this stops Alzheimer's. "It's perhaps too easy to mock the notion that flossing your teeth may contribute to good brain health," says Margaret Gatz at the University of Southern California. And that may be part of why this idea hasn't yet taken off in mainstream

Curiosities

CHEMWATCH

medicine. "There is a history of dental and medical doctors working apart and not cooperating," says Thomas Kocher at the University of Greifswald, Germany. But it also reflects the long-held belief that heart attacks and the other conditions are primarily the result of bad lifestyle, not bacteria. Such underlying paradigms in science can take decades to change. That happened when bacteria, not stress and stomach acid, were shown to cause stomach ulcers. After decades pursuing these explanations, many medical experts are reluctant to admit that amyloid may not cause Alzheimer's and high cholesterol may not lead to heart disease. With the world's population ageing, we don't have decades before these diseases become a health crisis severe enough to break health systems and societies. We need a new paradigm. That means facing the possibility that it may all be down to germs, after all.

New Scientist, 7 August 2019

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

A Major Cyber Attack Could Be Just as Deadly as Nuclear Weapons, Says Scientist

2019-08-28

People around the world may be worried about nuclear tensions rising, but I think they're missing the fact that a major cyberattack could be just as damaging – and hackers are already laying the groundwork. With the US and Russia pulling out of a key nuclear weapons pact – and beginning to develop new nuclear weapons – plus Iran tensions and North Korea again test-launching missiles, the global threat to civilization is high. Some fear a new nuclear arms race. That threat is serious – but another could be as serious, and is less visible to the public. So far, most of the well-known hacking incidents, even those with foreign government backing, have done little more than steal data. Unfortunately, there are signs that hackers have placed malicious software inside US power and water systems, where it's lying in wait, ready to be triggered. The US military has also reportedly penetrated the computers that control Russian electrical systems.

Many intrusions already

As someone who studies cybersecurity and information warfare, I'm concerned that a cyberattack with widespread impact, an intrusion in one area that spreads to others or a combination of lots of smaller attacks, could cause significant damage, including mass injury and death rivalling the death toll of a nuclear weapon. Unlike a nuclear weapon, which would

Curiosities

CHEMWATCH

vaporise people within 100 feet and kill almost everyone within a half-mile, the death toll from most cyberattacks would be slower. People might die from a lack of food, power or gas for heat or from car crashes resulting from a corrupted traffic light system. This could happen over a wide area, resulting in mass injury and even deaths. This might sound alarmist, but look at what has been happening in recent years, in the US and around the world. In early 2016, hackers took control of a US treatment plant for drinking water, and changed the chemical mixture used to purify the water. If changes had been made – and gone unnoticed – this could have led to poisonings, an unusable water supply and a lack of water. In 2016 and 2017, hackers shut down major sections of the power grid in Ukraine. This attack was milder than it could have been, as no equipment was destroyed during it, despite the ability to do so. Officials think it was designed to send a message. In 2018, unknown cybercriminals gained access throughout the United Kingdom's electricity system; in 2019 a similar incursion may have penetrated the US grid. In August 2017, a Saudi Arabian petrochemical plant was hit by hackers who tried to blow up equipment by taking control of the same types of electronics used in industrial facilities of all kinds throughout the world. Just a few months later, hackers shut down monitoring systems for oil and gas pipelines across the US. This primarily caused logistical problems – but it showed how an insecure contractor's systems could potentially cause problems for primary ones. The FBI has even warned that hackers are targeting nuclear facilities. A compromised nuclear facility could result in the discharge of radioactive material, chemicals or even possibly a reactor meltdown. A cyberattack could cause an event similar to the incident in Chernobyl. That explosion, caused by inadvertent error, resulted in 50 deaths and evacuation of 120,000 and has left parts of the region uninhabitable for thousands of years into the future.

Mutual assured destruction

My concern is not intended to downplay the devastating and immediate effects of a nuclear attack. Rather, it's to point out that some of the international protections against nuclear conflicts don't exist for cyberattacks. For instance, the idea of "mutual assured destruction" suggests that no country should launch a nuclear weapon at another nuclear-armed nation: The launch would likely be detected, and the target nation would launch its own weapons in response, destroying both nations. Cyber-attackers have fewer inhibitions. For one thing, it's much easier to disguise the source of a digital incursion than it is to hide where a missile blasted off from. Further, cyberwarfare can start small, targeting

Curiosities

CHEMWATCH

even a single phone or laptop. Larger attacks might target businesses, such as banks or hotels, or a government agency. But those aren't enough to escalate a conflict to the nuclear scale.

Nuclear grade cyberattacks

There are three basic scenarios for how a nuclear grade cyberattack might develop. It could start modestly, with one country's intelligence service stealing, deleting or compromising another nation's military data. Successive rounds of retaliation could expand the scope of the attacks and the severity of the damage to civilian life. In another situation, a nation or a terrorist organisation could unleash a massively destructive cyberattack – targeting several electricity utilities, water treatment facilities or industrial plants at once, or in combination with each other to compound the damage. Perhaps the most concerning possibility, though, is that it might happen by mistake. On several occasions, human and mechanical errors very nearly destroyed the world during the Cold War; something analogous could happen in the software and hardware of the digital realm.

Defending against disaster

Just as there is no way to completely protect against a nuclear attack, there are only ways to make devastating cyberattacks less likely. The first is that governments, businesses and regular people need to secure their systems to prevent outside intruders from finding their way in, and then exploiting their connections and access to dive deeper. Critical systems, like those at public utilities, transportation companies and firms that use hazardous chemicals, need to be much more secure. One analysis found that only about one-fifth of companies that use computers to control industrial machinery in the US even monitor their equipment to detect potential attacks – and that in 40 percent of the attacks they did catch, the intruder had been accessing the system for more than a year. Another survey found that nearly three-quarters of energy companies had experienced some sort of network intrusion in the previous year. But all those systems can't be protected without skilled cybersecurity staffs to handle the work. At present, nearly a quarter of all cybersecurity jobs in the US are vacant, with more positions opening up than there are people to fill them. One recruiter has expressed concern that even some of the jobs that are filled are held by people who aren't qualified to do them. The solution is more training and education, to teach people the skills they need to do cybersecurity work, and to keep existing workers up to date on the latest threats and defence strategies. If the world is to hold off

Curiosities

CHEMWATCH

major cyberattacks – including some with the potential to be as damaging as a nuclear strike – it will be up to each person, each company, each government agency to work on its own and together to secure the vital systems on which people's lives depend.

Science Alert, 18 August 2019

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

You Could Be “Smoking” a Pack of Cigarettes a Day Just by Breathing in City Air

2019-08-28

Want to know just how badly polluted the air we're breathing is getting? It can be as harmful for your lungs as a pack of cigarettes a day, new research has revealed. The new data might explain why more non-smokers are getting lung problems traditionally associated with smoking. This latest study looked specifically at emphysema, a condition which destroys the air sacs in the lungs; it can cause wheezing, coughing and shortness of breath, as well as increasing the risk of death. Researchers found that higher levels of pollutants in city air – ozone in particular – could cause emphysema to progress as quickly as would be expected from smoking an entire pack of cigarettes every day. “Rates of chronic lung disease in this country are going up and increasingly it is recognised that this disease occurs in non-smokers,” says physician-epidemiologist Joel Kaufman, from the University of Washington. “We really need to understand what's causing chronic lung disease, and it appears that air pollution exposures that are common and hard to avoid might be a major contributor.” This was an extensive study too, covering 7,071 participants between 2000 and 2018 in six metropolitan regions in the US: Chicago, Winston-Salem in North Carolina, Baltimore, Los Angeles, Saint Paul in Minnesota, and New York City. Data was pulled from air and lung analysis in the Multi-Ethnic Study of Atherosclerosis (MESA). Having an ambient ozone level just 3 parts per billion (ppb) higher than another area, over 10 years, is comparable in terms of emphysema progression to smoking a pack of cigarettes a day for 29 years, the study found. On average, the levels of ozone in the six study areas covered the 10-25 ppb range. “We were surprised to see how strong air pollution's impact was on the progression of emphysema on lung scans, in the same league as the effects of cigarette smoking, which is by far the best-known cause of emphysema,” says Kaufman. And ground-level ozone is on the rise, produced when fossil fuel pollutants react with ultraviolet light. While ozone is a useful barrier to UV up in the higher atmosphere, it's not something we want to be

Want to know just how badly polluted the air we're breathing is getting? It can be as harmful for your lungs as a pack of cigarettes a day, new research has revealed.

Curiosities

CHEMWATCH

inhaling down on the ground. By itself, a link between air pollution and health problems is nothing new – bad air is obviously bad for us – but this particular study really puts into perspective how much damage we can be doing to our bodies just by breathing in the city air. The researchers say this is the first longitudinal study to look at the long-term effects of air pollutants on percent emphysema, using a large, community-based, multi-ethnic group of people as study participants. The data that went into the study included detailed air pollution readings at many participants' homes, along with more than 15,000 CT scans. There is a small bit of good news: as the study found in its readings, levels of polluting particulates in the air are actually dropping in the US, though ozone is bucking this trend. Other statistics are less encouraging, with the World Health Organisation recently reporting that the majority of the world's children are breathing dangerously polluted air, and pollution being linked to a growing number of health problems. "As temperatures rise with climate change, ground-level ozone will continue to increase unless steps are taken to reduce this pollutant," says epidemiologist Graham Barr, from Columbia University in New York. "But it's not clear what level of the air pollutants, if any, is safe for human health." The research has been published in JAMA.

Science Alert, 16 August 2019

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

We 'eat a credit-card worth of plastic' a week. Do water filters help?

2019-08-28

A new review by the World Health Organisation (WHO) has found that the potential health risks from consuming microplastics in our drinking water are not yet known. Microplastics are "ubiquitous" in the food we eat and in drinking water, both bottled and tap, the report said. Australian research revealed in June that, on average, we could ingest about five grams of plastic every week which is the equivalent weight of a credit card. However, the health impact is unclear and requires further research. "We urgently need to know more about the health impact of microplastics because they are everywhere – including in our drinking-water," says Dr Maria Neira, director of the Department of Public Health, Environment and Social Determinants of Health at WHO. "Based on the limited information we have, microplastics in drinking water don't appear to pose a health risk at current levels. But we need to find out more. We also need to stop the rise in plastic pollution worldwide." Associate Professor Duncan McGillivray from the School of Chemical Sciences at the University of

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Curiosities

CHEMWATCH

Auckland said we are more exposed to microplastics than we think. "There are studies that have shown the presence of as much as 1000 particles per litre of bottled water," McGillivray said, adding that we shouldn't "panic" about microplastic but we "should not relax" either: "There are too many unknowns about how microplastics impact health." Concerns about the possible effects of ingesting microplastics include that they could damage the immune system, cause inflammation, or carry toxins such as mercury or pesticides. In sea mammals, plastics are thought to damage fertility. Until there is greater understanding about the health effects, some experts suggest drinking filtered water to help remove microplastics along with the pharmaceuticals and illicit drugs that have also been found in drinking water supplies around the world. "Opting for filters would aid in the removal of the microplastics. It would also aid in the removal of other pollutants like heavy metals and pathogens," said Dr Paul Harvey, an environmental scientist and environmental chemist at Macquarie University. Thava Palanisami, a senior research fellow at the University of Newcastle's Global Centre for Environmental Remediation, agrees. "Microplastics in drinking water is increasingly abundant, but it is geographic dependent as well," said Palanisami. Studies have not yet looked exclusively at the levels in Australia. "At present, there is sufficient evidence to understand the human health impact of plastic-related chemicals (BPA, phthalates) but not for microplastics yet. "Filtration is one of the simple options that can be applied, it will reduce the exposure to all the particle pollutants in water to a certain level." Not all filters are the same quality or as efficient as each other (though Choice provides a guide) and, of course, they are only part of the solution. "Using filters is a good strategy for 'cleaning up' the problem, but a far more effective approach is to remove the sources of pollution before they reach the drinking water," Dr Harvey said. "In Australia, we have a lot of complacency about drinking water pollution because we are told by regulators that there is no problem and there is very little solid research to back up anecdotal concerns raised by the community."

Sydney Morning Herald, 26 August 2019

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

Israeli Researchers Are Using 3D Printing Technology To Help Rebuild Coral Reefs

2019-08-28

A project to help rebuild coral reef systems around the world has been developed using a 3D printing model to create artificial coral structures,

Coral reef systems are being continuously degraded worldwide. This technology, now being applied off the coast of Eilat, helps rebuild the diversity of the underwater ecosystem.

Curiosities

CHEMWATCH

according to research published by three universities. Coral reef systems are being continuously degraded worldwide. This technology, now being applied off the coast of Eilat, will help to rebuild the diversity of the underwater ecosystem by introducing these manufactured structures into systems that are becoming unable to regenerate themselves. Coral reefs are disappearing for many reasons, due to causes both natural and man-made, mainly from waters overheated by climate change, dynamite fishing, and chemicals in sunscreen that reach the reefs. Invasive fish – such as the lion fish, which hunts in coral reefs – also cause them much damage. Over 30% of the Great Barrier Reef, the world's largest coral reef system located in the Coral Sea off the coast of Australia, was knocked out by heat waves occurring in 2016 and 2017, raising water temperatures to uninhabitable levels for these natural systems. Scientists have indicated that if the Earth's average temperature rises another four degrees Fahrenheit, almost all of the world's coral reef systems will be lost, which are used as essential nurseries for many species of fish that feed over a billion people a year. The 3D-printed reefs can imitate natural shapes that attract different species of fish, which will use these artificial structures as their nurseries in an attempt to bring back the lively population of fish that once inhabited the coral reefs of Eilat. "Many factors are known to affect the possible recruitment of reef organisms and especially fish," the researchers said. "One important factor is the structural complexity of a coral colony, which in turn provides shelter to residing fish. It has been shown that a coral structural complexity correlates with the reef biodiversity." The 3D printer – developed by researchers at the Technion-Israel Institute of Technology, Ben-Gurion University of the Negev and Bar-Ilan University – uses polyactic acid, a biodegradable and bio-active bio-plastic made from corn, cassava or sugarcane, to produce these column-like structures that are then installed into the water. From there, the columns are planted individually with farmed coral to mimic the complexities of coral reef ecosystems. These efforts will in theory bring important species of fish back to these areas in an attempt to completely reconstruct the barren reefs along the coast of Eilat. The scientists have played around with many different shapes, colours and materials to come up with the final design of the product being introduced off the coast of Israel. Early indicators suggest that the preferences of many of these species differ depending on contrasting combinations of material and colour. "As a research group that is composed of marine biologists and designers, we seek to find the next practices and tools to explore ecological functionality of coral morphology," said the researchers. "We believe that coral reef rehabilitation and management as well as artificial reef construction require better understanding of how the single coral

Curiosities

CHEMWATCH

colony morphology interacts with its inhabitants.” In this specific study, the scientists are using 3D manipulation and printing to further understand whether man-made structures can foster a natural ecosystem where species of fish that are essential for these ecosystems can flourish, as well as the advantages of using advanced design tools such as 3D scanning and manipulation to create artificial corals. “A successful implementation of this study may enhance our understanding of coral interactions with their surrounding environment, provide design tools for public displays such as large-scale aquariums and hence reduce their dependence on live corals, and provide a valuable design guidelines and tools when approaching the matter of active coral reef restoration,” the researchers explained. “The biological results of the research need to be processed and analysed further before they can be published. Yet, the design part of the process terminated with the second phase, in which 20 objects were installed in the Red Sea for observation. Initial results show that fish and invertebrates are using the 3D-printed corals and finding them a good ‘home’ that they trust laying their eggs [in];” they concluded.

The Jerusalem Post, 25 August 2019

<https://www.jpost.com/>

Emails Show Monsanto Orchestrated GOP Effort To Intimidate Cancer Researchers

2019-08-28

In 2015, the World Health Organisation’s cancer research arm, the International Agency for Research on Cancer, classified glyphosate, an active ingredient in the herbicide Roundup, as a “probable carcinogen,” setting off a global debate about the world’s most popular weedkiller. Over the last four years, Republicans in Congress have excoriated and pushed to defund the IARC, casting their defence of the chemical as a quest on behalf of small American farmers. Rep. Frank Lucas, R-Okla., has written that his outrage over the cancer research is on behalf of the “farmers and food manufacturers who rely on traditional farming methods to produce the food that fuels America — and the world.” But according to a recent trove of documents, the ongoing political assault on the IARC has been scripted in part by Monsanto, the St. Louis-based chemical and seed conglomerate that produces Roundup and Roundup-resistant crops. Roundup has been cash cow for the company since the 1970s, fuelling billions of dollars in annual profits. Its use has skyrocketed in recent decades since the company developed genetically modified corn and other crops that are resistant to it; it is now the world’s leading

In 2015, the World Health Organisation’s cancer research arm, the International Agency for Research on Cancer, classified glyphosate, an active ingredient in the herbicide Roundup, as a “probable carcinogen,” setting off a global debate about the world’s most popular weedkiller.

Curiosities

CHEMWATCH

herbicide. A growing number of individuals say that Monsanto failed to warn consumers of the dangers of using Roundup and had marketed the chemical spray as harmless to humans, while internally recommending that its own employees use gloves and protective gear. Critics say that the Roundup formula used in the U.S. also contains a surfactant that makes the herbicide far more toxic than the variation of the spray sold in the European market. Monsanto, which merged with German multinational pharmaceutical company Bayer AG last year, is facing as many as 11,000 cases relating to glyphosate. Last year, Dewayne Johnson, a former groundskeeper now dying of cancer, was the first to win his jury trial in San Francisco state court against Monsanto, alleging that years of using Roundup contributed to his non-Hodgkin's lymphoma. Johnson was awarded \$289 million by a jury, though a judge later reduced the amount to \$78 million. Another plaintiff, Edwin Hardeman, also alleged that he spent decades spraying the glyphosate-based weedkiller with little to no protective gear and developed the same blood cancer, won a similar case in federal court this year. Plaintiff Dewayne Johnson looks on after hearing the verdict in his case against Monsanto at the Superior Court of California in San Francisco on 10 August 2018. The newly disclosed files, released by a plaintiff's law firm, Baum Hedlund, include company emails, documents, and deposition transcripts showing that Monsanto lawyers and lobbyists guided lawmakers, coordinating efforts to question the IARC's credibility and slash U.S. support for the international body. The company has denied claims that its products cause cancer, and Monsanto lawyers have declared that Environmental Protection Agency's designation of glyphosate as safe should clear the company of any legal liability. In a recent marketing campaign, Bayer touted its friendly cooperation with regulators as a sign that the public should have nothing to fear from its products. But the documents also suggest that the firm has used its influence with lawmakers to antagonise regulators, applying pressure and investigative threats to shape the science used to research glyphosate and other controversial chemical compounds, as part of a larger campaign to silence critics and discredit the IARC. In June 2015, Michael Dykes, then serving as Monsanto's vice president of government affairs, laid out the company's strategy for "managing the IARC issue," following the cancer research centre's determination that March. The company, he wrote in an email, had dispatched its team of lobbyists to brief "key staff at EPA, USTR, USDA, and the State Department as well as members of Congress" to raise concerns with the IARC's scientific process, and with how the decision could impact agriculture as well as international trade. Lobbyists also met with an official at the Department of Health and Human Services; they saw the agency's support as key "to secure a WHO clarification." Later in the

Curiosities

CHEMWATCH

year, Dykes updated the Monsanto team with plans to push back against the IARC, including the possible placement of advertisements — in the form of letters from third-party groups — in Capitol Hill newspapers, as well as preparation to use a Senate Agriculture Committee hearing as a venue to get the EPA to reaffirm support for glyphosate. “We will make sure Committee members ask EPA the glyphosate safety question,” Dykes wrote.

The following year, FTI Government Affairs, one of several consulting firms guiding Monsanto’s political response to the IARC decision, assisted GOP lawmakers with an effort to investigate U.S. support for the IARC. In one email sent by Todd Rands, a former Monsanto attorney working with FTI, sent a draft of a letter ostensibly written by Rep. Rob Aderholt, R-Ala., a senior lawmaker on the House Appropriations Committee, addressed to Dr. Francis Collins, the director of the National Institutes for Health. NIH is the government agency responsible for most federal public health research and is the largest funder to the IARC. The letter, in fact, had been written by FTI consultants, along with Rands’s edits, according to his deposition testimony. The FTI-written letter declared that glyphosate “does not cause cancer,” accused the IARC of peddling “bunk science,” and threatened a reassessment of the NIH budget to ensure that the agency is “committed to only funding organizations that produce information and conclusions based on sound science, robust processes, and credible methodology.” During his deposition, Rands said that he believed it appropriate for Monsanto to draft a letter on behalf of a lawmaker to NIH, calling such ghost-writing a “common practice in Washington.” It’s not clear what Aderholt’s office did with the FTI-authored letter. Aderholt’s office did not respond to a request for comment from The Intercept. On June 2, 2016, Aderholt sent a letter to NIH to request a briefing on the IARC’s designation of glyphosate as a probable carcinogen and “the standards that NIH places on research funded by the U.S. taxpayers,” a letter that mirrored many of the demands in the FTI letter, though it used different language. More GOP letters and demands for investigation over NIH’s funding for IARC followed. Rep. Jason Chaffetz, R-Utah, then-chairman of the House Oversight Committee, Rep. Trey Gowdy, R-S.C., Chaffetz’s successor as Oversight chair, and Rep. Lamar Smith, R-Texas, then-chair of the House Science Committee, all called for inquiries into IARC funding and the designation of glyphosate as a carcinogen. The Monsanto lobbyists closely conferred with the committees as they honed in on the IARC’s funding. Drew Feeley, an attorney for the GOP staff of the House Oversight Committee, emailed an FTI consultant to explain that his office was working to attach a line to a government

Curiosities

CHEMWATCH

budget bill designed “to apply to IARC” in order to slash its funding over the glyphosate issue. “Thanks again for coordinating,” Feeley wrote to the Monsanto consultant. Feeley, notably, is now serving as an attorney with the Council on Environmental Quality, the White House office that oversees environmental policy. “We expect the House OGR investigation about IARC to expand as they move into the new administration,” wrote Rands, in an update to Monsanto colleagues. Last year, under Smith, the House Science Committee devoted an entire committee hearing into questioning the IARC, with a focus on its conduct around glyphosate. Smith subsequently sent more letters to cancer researchers in Norway, demanding they “correct the flaws in IARC.” The House Appropriations Committee followed up by cutting \$2 million in funding to the IARC, a symbolic move to distance the U.S. from the international body, which relies on a budget of around \$40 million from a range of member countries. The Congressional outreach was only part of a multifaceted effort to control the backlash sparked by the IARC designation. In recent years, a great deal of new information has come to light around Monsanto’s work to conceal the potential health risks around glyphosate. Earlier this month, new documents revealed that Monsanto operated a “fusion centre” to discredit critics of the company, including former Reuters journalist Carey Gillam, who has written extensively about glyphosate. The operation even monitored and considered legal action against singer Neil Young, a critic of Monsanto. Le Monde, the French newspaper, published an award-winning investigation on the controversy, referring to the Monsanto-run campaign to discredit the IARC as an effort to “intimidate” the cancer research centre. A separate cache of litigation files, released in May, revealed that Monsanto also contracted with Hakluyt, a corporate intelligence firm, to keep close tabs on political elites in Washington. The company consulted with senior Trump and EPA officials, and confirmed that the administration would support Monsanto on glyphosate issues. “We have Monsanto’s back on pesticide regulation,” a domestic policy adviser in the White House told Hakluyt. The last year has exposed other cloak-and-dagger tactics. The company was criticised for ghost-writing scientific studies on the safety of glyphosate, which were presented as independent research. At the San Francisco civil trial over glyphosate, an FTI consultant working for Monsanto was caught posing as a journalist working for the BBC and another British outlet. And in 2017, one of the most stunning disclosures revealed that a senior EPA staffer, Jess Rowland, had quietly tipped Monsanto off to the fact that federal agencies had sought to re-evaluate the safety of glyphosate, boasting to the company that he could “kill” federal investigations into glyphosate. Shortly before a crucial European Union vote on glyphosate products, the EPA suddenly

Curiosities

CHEMWATCH

released a report declaring the safety of the product. The document was later taken down because it had not yet been completed. One Monsanto official relayed to a colleague that Rowland had told him, "If I can kill this, I should get a medal," in regards to the glyphosate review conducted by the Agency for Toxic Substances and Disease Registry, a department of Health and Human Services. After leaving the EPA, Rowland went to work in the private sector, consulting for chemical companies. There's also a revolving door between lawmakers supporting Monsanto and professionals working on behalf of the company. Shortly after retiring from Congress this year, following his investigation of the IARC, Lamar Smith took a job at Akin Gump Strauss Hauer & Feld LLP, a lobbying firm that represents Bayer-Monsanto's interests in Washington.

After publication, Bayer sent the following statement: "None of the documents cherry-picked by plaintiffs' lawyers and their surrogates contradict the findings of the extensive body of science and conclusions of leading health regulators that glyphosate-based herbicides are safe when used as directed and that glyphosate is not carcinogenic. Instead, they show that Monsanto's activities were intended to ensure there was a fair, accurate and science-based dialogue about the company and its products in response to significant misinformation. We take the safety of our products and our reputation very seriously and work to ensure that everyone – from regulators to customers to other stakeholders – has accurate and balanced information to make decisions about our products."

The Intercept, 23 August 2019

<https://theintercept.com>

Workers at Big Government Lab Sue Over Exposure to a Toxic Chemical

2019-08-28

As a technician at Brookhaven National Laboratory, one of the nation's most prestigious science labs, Joseph Marino's job in the late 1990s and early 2000s was to clean and maintain the supercomputers that have helped researchers unlock some of the world's biggest scientific and medical mysteries. He polished copper connectors, he said, until "they reminded you of gold." One of the cleaning fluids he used while wiping the machines by hand over the years was trichloroethylene, or TCE, a toxic degreaser that the Trump administration has targeted as part of its broad effort to weaken regulations on chemicals. TCE is still widely used by dry cleaners as a stain remover and by factories as a degreaser.

Curiosities

CHEMWATCH

Mr. Marino, who later lost a kidney to cancer, is now suing the operators of the Department of Energy lab for \$25 million over exposure to TCE, alleging that they negligently supplied the cleaner to him and many other workers there without warnings or protections. He is also suing Dow Chemical and Zep, alleging that they made and sold the chemical without adequate safety warnings. The lawsuit is a rarity. Most TCE claims are settled through a limited workers' compensation system that, in Mr. Marino's case, awarded him \$50,000 for his exposure to the chemical, plus \$15,000 a year for lost wages — sums he says barely cover his health care. So, Mr. Marino chose to take on the operators of the lab directly, opening up a significant new battle front. "There were higher-ups who knew about the contaminants. They knew about the dangers," said Mr. Marino, 60, one recent morning at his home on Long Island, where he lives with his wife and two dogs. Recently, a second former technician, Ronald Yuhas, 77, filed a similar suit. If successful, the lawsuits could prompt more workers exposed to TCE for decades to sue over workplace exposure. The lawsuits take on added resonance at a time when the Trump administration is rolling back protections against TCE. Under President Barack Obama, the Environmental Protection Agency took steps to restrict the chemical, declaring it "carcinogenic to humans by all routes of exposure" and proposing a ban on two of its high-risk uses — in spot dry cleaning, and as a degreasing spray at factories. But, at the urging of industry groups including the American Chemistry Council, the EPA has indefinitely delayed the ban, leaving as many as 178,000 workers exposed to the chemical, according to EPA estimates. Now that the Trump administration has delayed the TCE restrictions, "very few facilities are actually making a move to safer alternatives because they were waiting to see what EPA will do," said Liz Hitchcock, acting director for Safer Chemicals, Healthy Families, a Washington-based group that supports stricter safety rules. A Department of Energy official, who initially said she was looking into the matter, did not respond to subsequent requests for comment. Dow declined to comment beyond saying that it no longer manufactures or sells TCE. Zep, based in Atlanta, did not respond to requests for comment sent through its website, nor did it respond to queries left with its investor relations and customer service lines. It markets TCE in spray cans for the cleaning of power tools, electric motors, printing equipment, typewriters and office equipment, according to the site. The Brookhaven cases touch on the darker legacy of a world class research lab that has contributed to seven Nobel Prizes, including the 2009 prize in chemistry for research into DNA, for which researchers carried out X-ray work at Brookhaven.

[National Laboratory](#)

Curiosities

CHEMWATCH

The sprawling, 5,300-acre site, built in 1947, has a history of leaks and spills of radioactive or toxic materials, much of it from the Cold War years when national security interests overshadowed environmental and health protections. In the late 1990s, the lab disclosed that radioactive tritium had been leaking into nearby groundwater for more than a decade from a storage tank filled with spent fuel rods beneath a research reactor at the lab. The site has also suffered several spills of TCE, and a plume of the chemical extends in the groundwater beyond the boundaries of the lab, according to EPA maps. At a recent meeting of a group of Brookhaven retirees, at a classic Long Island diner a 20-minute drive from the lab, the conversation was punctuated with news of former colleagues who were battling disease or who had died. Around the table was Frank Devito, 84, in a faded Yankees cap, who worked at the lab for three decades, does dialysis three times a week for renal failure and keeps the group's tally of deceased colleagues — 38 at the latest count. There was also Fred Squires, 67, who remembers scrubbing parts in a tray full of TCE, with rubber gloves and no mask, and who has kidney cancer. There was Jerry Hobson, 64, a former rigger at the site who suffered a kidney failure and recently had his workers' compensation application denied. And Mr. Yuhas, 77, who rose to shift supervisor during his four-decade career at Brookhaven and later learned he had renal cystic disease and chronic kidney impairment. "It was all over the whole laboratories, in spray cans," Mr. Yuhas said of TCE. The Brookhaven lab is a town in itself, with its own post office, fire department, gymnasiums and swimming pool. Former workers describe their colleagues as their family. And government records show that the Department of Energy took steps to address the risks posed by toxic chemicals to workers at its labs. The department, in fact, halted the use of trichloroethylene in its facilities in 1990, after studies linked the chemical to health risks. In his lawsuit, Mr. Marino, who was sent to work at the lab by two separate staffing agencies, alleges that Brookhaven contractors instead stockpiled the chemical in drums and directed workers to use it until as recently as 2006. Unaware of the dangers, hundreds of technicians continued to use trichloroethylene — trichlor, they called it — to maintain the site's advanced computers. In one episode at the facility, Mr. Marino alleges in his lawsuit, the chemical hung so thick in the air, a manager told the staff not to worry because the radiation "will kill you before the fumes from that stuff does." In 1997, the Department of Energy fired a non-profit organisation that had run the lab since its inception, Associated Universities, and hired Brookhaven Science Associates, a partnership between the State University of New York at Stony Brook and the contractor Battelle. The lab, which today employs about 2,500 scientists and other staff members, has been a

Curiosities

CHEMWATCH

Superfund clean-up site since the late 1980s. Both Associated Universities and Brookhaven Science Associates are named as defendants. Former representatives for Associated Universities could not be reached. Battelle referred questions to Brookhaven Science Associates, where a spokesman, Peter Genzer, said the lab did not comment on litigation. As many as 2,200 facilities still use TCE to remove grease from metal parts, and four out of five of the country's approximately 65,000 dry cleaners use it as a stain remover, according to EPA estimates. Because of its more widespread use in the past, it contaminates more than 700 sites across the country and is present in the drinking water of 14 million Americans, the bipartisan non-profit group Environmental Working Group estimated last year. The Trump administration shelved the Obama-era restrictions on TCE use in the workplace after lobbying by the American Chemistry Council, the industry group. In emailed comments, the lobby group said that it had not advocated for the elimination of TCE regulations, and rather had suggested exemptions for critical uses. The Department of Energy says it no longer uses TCE at its facilities. Former Brookhaven lab workers gathered at the diner say that decision came decades too late. "This can't happen to anybody else," Mr. Marino said.

New York Times, 22 August 2019

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

Retail giants face pressure to change chemical-coated receipt paper

2019-08-28

Some of Canada's biggest retailers started testing alternatives to receipt paper that's coated in potentially dangerous chemicals, as pressure mounts for them to phase it out by the end of this year. "We urge you to take immediate steps to stop using thermal paper containing bisphenols for receipts and other paper products in Canada," reads a letter from a conglomerate of health, labour and environmental groups sent to 13 retailers, including major grocers and fast-food chains. "BPA is a hormone-disrupting chemical that can interfere with the critical function of hormones in the human body and has been found to damage fertility, harm the foetus, and cause adverse health outcomes including cancers of the breast and prostate, diabetes, and attention deficit hyperactivity disorder (ADHD) in children." Bisphenol A (BPA) is an industrial chemical that is used in making polycarbonate, a type of plastic, and epoxy resins. The Canadian government declared BPA a toxic chemical in October 2010, finding it "constitutes or may constitute a danger to human health and

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Curiosities

CHEMWATCH

the environment” based on criteria set out in the Canadian Environmental Protection Act. The government made it illegal to manufacture, import, advertise or sell baby bottles with the chemical that same year. Some retailers removed BPA-coated receipt paper, but replaced it with nearly identical bisphenol substances, like BPS, according to the groups, which include Environmental Defence, the United Food and Commercial Workers Canada, and Breast Cancer Action Quebec. They say these coatings pose a risk to retail workers and consumers. “The notion that ... by doing one’s job that one is being exposed to these toxins would quite naturally concern us,” said Derek Johnstone, a spokesman for the UFCW Canada, which represents thousands of cashiers. “It’s something that is within the control of all major retailers in Canada,” he said, adding he’d like to see companies commit to a timeline for removing these chemicals from their receipts. Loblaw Companies Ltd., one of the companies the letter targeted, stopped using BPA receipts in 2012, wrote spokeswoman Catherine Thomas in an email. It plans to transition away from bisphenol-coated receipts completely in the future and is already testing alternative papers, she said, adding the company also offers electronic-receipt or no receipt options at almost all of its stores now, and offers workers gloves. She declined to provide a timeline for when Loblaw would no longer use bisphenol-coated receipts, saying the company is in the early stages of testing. The Home Depot Canada’s receipts have been BPA-free for more than a decade, wrote spokeswoman Erika Botond in an email, adding “they are in complete compliance with all regulations.” She did not answer whether the receipt paper is coated with BPS or other bisphenol substances. Cineplex Inc., Metro Inc., Walmart Canada Corp. and McDonald’s Canada deferred questions to the Retail Council of Canada. Many retailers have switched to BPA-free paper, while others intend to stop using bisphenol-coated paper completely and have started testing alternatives, wrote spokesman Andrew Telfer. The council would not answer questions about the four companies that deferred questions to it. It “does not otherwise comment on business decisions including the sourcing of supplies and equipment,” he said. Seven other companies who received the letter — A&W Food Services of Canada Inc., Best Buy Canada Ltd., Canadian Tire Corp. Ltd., Costco Wholesale Canada Ltd., Empire Co. Ltd., Lowe’s Canada and Restaurant Brands International Inc. — did not immediately respond to a request for comment.

Times Colonist, 21 August 2019

<https://www.timescolonist.com>

Curiosities

CHEMWATCH

Toxic chemicals can enter food through packaging, so we made a list

2019-08-28

In the late 1980s, the Council of Northeast Governors (CONEG) was concerned that heavy metals in packaging would accumulate in recycled materials to levels that presented serious health concerns. The organisation drafted model legislation that prohibited the intentional addition of mercury, lead, cadmium and hexavalent chromium to any component of packaging, including inks. It also set a 100 parts-per-million limit on the total amount of these four heavy metals. To ensure compliance, companies making packaging materials had to provide certificates of compliance to downstream purchasers and report compliance to the states. CONEG also established the Toxics in Packaging Clearinghouse to maintain the model legislation, coordinate implementation of state legislation and serve as a resource for companies seeking compliance information. The council's hypothesis: protecting virgin material from contamination will improve the recyclability of post-consumer materials and protect public health. Over the years, 19 states have adopted a variation of the model legislation. In 2018, Washington state took an unprecedented step of expanding its version of the legislation from heavy metals to include per- and poly-fluorinated alkyl substances (PFAS). PFAS are bioaccumulating, persistent chemicals and are associated with an array of health problems including endocrine disruption and children's developmental harm. The state was concerned that paper and cardboard food packaging treated with these chemicals may be contaminating composting (PDF) and paper recycling processes post-consumer. In addition to heavy metals and PFAS, EDF has identified other chemicals in food packaging and food handling equipment, whose ubiquity and potential health impacts raise serious concerns about food safety and contamination of the recycling stream. These chemicals appear in either plastic or paper packaging or both.

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Intentionally added ingredients

1. Ortho-phthalates (primarily used in plastic but many other uses including printing inks): Studies show that these chemicals are linked to endocrine disruption, developmental and reproductive toxicity. Their contamination of food is widespread. Their safety is under review by FDA.
2. Perchlorate (anti-static agent used in plastic for dry food and in food handling equipment): This chemical disrupts the thyroid gland's normal function and reduces production of the thyroid hormone needed for

Curiosities

CHEMWATCH

healthy foetal and child brain development. Food contamination is widespread; especially problematic is the increase of perchlorate levels in baby food and dry cereal. The safety of perchlorate is under review by FDA.

3. Per- and poly-fluorinated alkyl substances (grease-proofing agent used in paper packaging): PFAS, often distinguished as long-chain or short-chain, are bioaccumulating, persistent chemicals associated with an array of health problems including endocrine disruption and children's developmental harm. There is widespread human exposure to PFAS; water and food are the likely sources. PFAS in food packaging will be banned in Washington two years after the state finds suitably available safer alternatives or in 2022, whichever date gives manufacturers more time to redesign packaging.

4. Benzophenone (used as a plasticiser in rubber articles intended for repeat use): Citing the carcinogenic evidence regarding benzophenone, FDA has banned its use as a flavour and in food packaging. The bans go into effect in 2020.

Residual processing aids

1. Ethyl and methyl glycol, toluene and n-methyl-pyrrolidone (NMP): These solvents, often used in printing inks, leave residues in packaging and pose a risk of reproductive or development harm. Toluene and NMP have been targeted for removal in other product categories as well. Toluene has been targeted by a number of retailers, including Amazon and Rite-Aid, for removal from personal care and beauty products. NMP has been targeted for removal from paint strippers by several retailers including Home Depot, Lowes and Walmart. EPA has proposed banning use of NMP as a paint stripper and is expected to finalize that proposal for retail sales soon.

2. Bisphenol A, B, F, S (used to make epoxy lining in metal cans, to make polycarbonate plastic, and ink): One or more bisphenol compounds has been linked to endocrine disruption, developmental and/or reproductive toxicity. BPA is already banned for baby bottle use or coating of infant formula packaging. BPS became a common replacement to BPA in packaging, but recent studies demonstrate similar health concerns to BPA.

Contaminants

1. Heavy metals (lead, arsenic, cadmium, chromium V and mercury): These chemicals are highly toxic and have been regulated in a variety of applications. EDF has demonstrated heavy metal contamination in food, particularly baby food. Although not intentionally added, contamination

Curiosities

CHEMWATCH

of food packaging may be a source. FDA's Toxic Elements Working Group is evaluating children's exposure to heavy metals across all foods.

Initial promising steps to limit toxic chemicals in packaging

Last year, the Food Safety Alliance for Packaging (FSAP), a part of the Institute of Packaging Professionals, released "Food Packaging Product Stewardship Considerations" (PDF), a set of best practices to reduce problematic chemicals in food packaging. FSAP is supported by leading food manufacturers, including Nestle and Mars. Of our list above, FSAP said:

- Heavy metals and long-chain PFAS must not be used;
- Ortho-phthalates, BPA and toluene should not be used;
- Ethyl and methyl glycol use should be minimized; and
- Short-chain PFAS should only be used after considering alternatives.

Start clean

We want higher recycling rates of food packaging, and we want safer food. By ensuring future food packaging is free of these chemicals, companies can improve consumer trust while minimising the impact of future regulations on their bottom line. In addition, the risks these chemical additives and contaminants pose when used in virgin materials continue into recycled materials; unlike the purifying processes used in recycling metal and glass, conventional plastic and paper recycling processes do not remove these persistent toxic chemicals. We maintain that any company looking to create sustainable recycling markets for food packaging, particularly those companies developing strategies to meet the Ellen MacArthur Foundation's New Plastics Economy Global Commitment, must set tight virgin-material standards to prevent problematic contamination in post-consumer recycled materials. Taking action today helps to protect consumer health now and in the future. We will explore options and resources available to companies as part of this series. Stay tuned.

Green Biz, 23 August 2019

<https://www.greenbiz.com>

Technical Notes

CHEMWATCH

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

ENVIRONMENTAL RESEARCH

[Co-exposure to ketoconazole alters effects of bisphenol A in Danio rerio and H295R cells](#)

[Telomere dynamic in humans and animals: Review and perspectives in environmental toxicology](#)

[Identification of moracin N in mulberry leaf and evaluation of antioxidant activity](#)

[The dataset for antifeedant activity of eugenol derived compounds against red palm weevil \(*Rhynchophorus ferrugineus*, Olivier\) larvae](#)

[Green kiwifruit extracts protect motor neurons from death in a spinal muscular atrophy model in *Caenorhabditis elegans*](#)

MEDICAL RESEARCH

[Modelling the binding of diverse ligands within the Ah receptor ligand binding domain](#)

[Characterisation of rat glutathione transferases in olfactory epithelium and mucus](#)

[sAOP: Linking chemical stressors to Adverse Outcomes Pathway Networks](#)

[Toxicogenomic analyses of the effects of BDE-47/209, TBBPA/S and TCBPA on early neural development with a human embryonic stem cell in vitro differentiation system](#)

[Identification of potential endocrine disrupting chemicals using gene expression biomarkers](#)

OCCUPATIONAL RESEARCH

[Setting up a collaborative European human biological monitoring study on occupational exposure to hexavalent chromium](#)

[An atypical *Bacillus anthracis* infection in a bull-A potential occupational health hazard](#)

[Dermatitis among workers in Ontario: results from the Occupational Disease Surveillance System](#)

Technical Notes

CHEMWATCH

Urinary parabens in adults from South China: Implications for human exposure and health risks

Characterising Occupational Health Risks and Chemical Exposures Among Asian Nail Salon Workers on the East Coast of the United States

PUBLIC HEALTH RESEARCH

Bisphenol A and bisphenol S exposures during pregnancy and gestational age – A longitudinal study in China

Do stressful life events during pregnancy modify associations between phthalates and anogenital distance in newborns?

Application of new statistical distribution approaches for environmental mixture risk assessment: A case study

Oxidative Stress Markers, Trace Elements and Endocrine Disrupting Chemicals in Children with Hashimoto's Thyroiditis

Chemical characterisation and bioactivity of phenolics from Tieguanyin oolong tea