Bulletin Board

OCT. 11, 2019

CHEMWATCH

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CONTACT US

subscribers@chemwatch.net
tel +61 3 9572 4700
fax +61 3 9572 4777

1227 Glen Huntly Rd
Glen Huntly
Victoria 3163 Australia

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ASIA PACIFIC

Suspension of approval of the label for containers for 2,4-D products

2019-10-04

PART 1—SUSPENSION DECISION

On 1 October 2019, the Australian Pesticides and Veterinary Medicine Authority (APVMA) suspended the approval of the labels listed in the table in Part 3 of this notice; and determined that the instructions for possessing, having custody of, using or supplying the products bearing the suspended labels are as set out in this notice.

Labels may not meet the labelling criteria

- The approval of these labels has been suspended because the APVMA is of the view that they may not meet the labelling criteria (defined at s5D of the Code);
- The approval of the labels has been suspended because the APVMA is of the view that the labels may not meet the labelling criteria, defined at section 5D of the Code. The term "meets the labelling criteria" is defined in section 5D(1) of the Code and includes adequate instructions relating to the circumstances in which the product should be used and how the product should be used. The term "adequate" in relation to instructions on a label is defined in section 3 of the Code to mean adequate to ensure, as far as is reasonably practicable, that the product meets, amongst other things, the safety criteria. Relevantly, s5A(1)(c) of the Code, which contains the definition of "meets the safety criteria," stipulates that use of the product in accordance with any approved instructions "is not, or would not be, likely to have an unintended effect that is harmful to animals, plants or things or to the environment."
- The APVMA is satisfied that the effects of 2,4-D spray drift on non-target species is likely to have an unintended effect that is harmful to plants or to the environment, and that therefore the approval of labels for containers for 2,4-D products should be suspended.

Period of suspension

The suspension is for the period 1 October 2019 through 30 September 2020.

Definitions in this notice:

- *earlier approved label* means a label whose distinguishing number appears in column 5 of the table which was approved and complied with the relevant particulars recorded in the relevant APVMA file for the label immediately prior to the suspension decision;
- *relevant 2,4-D product* means a product whose distinguishing number appears in column 1 of the table and whose distinguishing name appears in column 2 of the table;
- *suspension decision* means the decision of the APVMA of 1 October 2019 to suspend the approval of labels for containers of each relevant 2,4-D product for twelve months;
- *spray drift instructions*, in relation to a registered chemical product mentioned in Column 1 bearing an earlier approved label mentioned in Column 5 of the table, means: (a) the instructions appearing in Permit Number PER87174; and (b) the instructions appearing in Permit Number PER87451;
- *table* means the table in Part 3 of this notice

Instructions for possessing, having custody of, or using the product

- as required, the APVMA has issued instructions for the supply, possession, custody and use of the products whose labels have been suspended as stipulated in PER87174 and PER87451.
- the instructions for possessing, having custody of, or using a product bearing an earlier approved label are the spray drift instructions.

Supply of the product

- the supply of the product bearing an earlier approved label may only take place if a copy of the spray drift instructions in accordance with Permit Number PER87174 is securely affixed to each container of the product.
- the new supply instructions constitute conditions of a permit taken to have been issued under s45B(1) and s45B(3) of the Code via Permit PER87174.

Consequences of failing to comply with new use instructions and/or new supply instructions

- the new use instructions constitute conditions of a permit taken to have been issued under s45B(1) and s45B(3) of the Code via Permits PER87174 and PER87451.
- it is an offence to contravene a condition of a permit. The pecuniary penalty for each contravention of a condition of the spray drift permit is:

- for an individual—up to $189,000; and
- for a body corporate—up to $315,000.

PART 2—SPRAY DRIFT INSTRUCTIONS

Division 1—All products

- the instructions in this Part are the *spray drift instructions* for a relevant 2,4-D product;
- use of a relevant 2,4-D product may only take place in accordance with:
- the instructions appearing on the earlier approved label attached to the product; and
- the instructions in Division 2 of Part 2 of this notice; and
- the instructions in Division 3 of Part 2 of these instructions which correspond to the product's group (as listed in column 4 of the table).

Instructions on earlier approved label disregarded in event of inconsistency

- in the event of any inconsistency between the instructions appearing on the earlier approved label for a product and the instructions in Divisions 2 and 3 of Part 2 of these instructions, the instructions in Divisions 2 and 3 of Part 2 of these instructions are to prevail to the extent of the inconsistency.

These instructions do not authorise additional uses

- these instructions do not authorise any person to use a relevant 2,4-D product:
- in any situation; or
- at any time; or
- in any state or territory;

if the person would not be authorised to use the product in that situation, at that time, or in that state or territory, as the case may be, under the instructions appearing on the *earlier approved label* attached to the container for the product.

EXAMPLE 1: if the earlier approved label for the product did not contain instructions for use on cereal crops, these instructions (which contain buffer zones relating to the use of products on cereal crops) DO NOT authorise the use of the product on cereal crops.

EXAMPLE 2: if the earlier approved label contained a condition stating that "this product may only be used from 15 April to 16 September unless

otherwise permitted by a state or territory authority", these instructions DO NOT alter that prohibition.

EXAMPLE 3: if the earlier approved label contained a condition which limited the use of the product to certain states or territories, these instructions DO NOT authorise the use of the product in other states or territories.

Division 2—Instructions applicable to each relevant 2,4-D product

- the instructions in this Division apply to each relevant 2,4-D product.

Directions for use:

As an outcome of the 2018 2,4-D Environmental Assessment report, several recommendations were made to ensure that 2,4-D products continue to be used in a manner that is safe for the animals, plants and the environment. The downwind mandatory no spray zones refer to specific product groupings and, in these cases, the following table provides a summary of group numbers and 2,4-D concentrations and forms in the respective group:

- USERS must first identify which group their product belongs to by identifying the Active Constituent and concentration of the product they intend to use from the product label.
- Table 2.1 provides a summary of the product groupings based on concentration and active ingredient.

Group	2,4-D FORM and other active constituents	Concentration (g/L)
1[1]	ISOPROPYLAMINE SALT	225
2	ISOPROPYLAMINE SALT	300
3	ISOPROPYLAMINE SALT	450
4	TRIISOPROPANOLAMINE SALT	300
	picloram	75
5	DIMETHYLAMINE SALT	500
6	DIMETHYLAMINE SALT	625
7	DIMETHYLAMINE SALT	800
8	DIMETHYLAMINE SALT	720

1 Group 1: There are currently no registered products in this product group.

Regulatory Update

Group	2,4-D FORM and other active constituents	Concentration (g/L)
8b	DIMETHYLAMINE/ (MONOMETHYLAMINE OR DIETHANOLAMINE) SALTS	700
9	DIMETHYLAMINE/ DIETHANOLAMINE SALTS	625
9b	DIMETHYLAMINE/ DIETHANOLAMINE SALTS	750
10	DIMETHYLAMINE/ DIETHANOLAMINE SALTS	475
11	DIETHANOLAMINE SALT	500
12	CHOLINE SALT	500
13	2,4-D FORM NOT SPECIFIED	300
14	SODIUM SALT	700
14b	SODIUM SALT	800
15	SODIUM SALT	22.8
15b	DIMETHYLAMINE SALT	100
16	DIMETHYLAMINE/ DIETHANOLAMINE SALTS	80
	mecoprop	336
	dicamba	40
16b	DIETHANOLAMINE SALT	350
	clopyralid	45
	dicamba	45
17	ETHYLHEXYL ESTER	577
	ioxynil	100
18	ETHYLHEXYL ESTER	600
19	ETHYLHEXYL ESTER	680
19b	ETHYLHEXYL ESTER	445
20	ETHYLHEXYL ESTER	421
	pyraflufen-ethyl	2.1
20b	ETHYLHEXYL ESTER	300
	florasulam	6.25

Group	2,4-D FORM and other active constituents	Concentration (g/L)
21	ETHYL ESTER OR ISOBUTYL ESTER	800

RESTRAINTS

- DO NOT apply in a manner that may cause an unacceptable impact to native vegetation, agricultural crops, landscaped gardens and aquaculture production, or cause contamination of plant or livestock commodities, outside the application site from spray drift. The buffer zones in the relevant buffer zone tables below provide guidance but may not be sufficient in all situations. Wherever possible, correctly use application equipment designed to reduce spray drift and apply when the wind direction is away from these sensitive areas.
- DO NOT allow bystanders to come into contact with the spray cloud.
- DO NOT apply unless the wind speed is between 3 and 15 kilometres per hour at the application site during the time of application.
- DO NOT apply if there are surface temperature inversion conditions present at the application site during the time of application. These conditions exist most evenings one to two hours before sunset and persist until one to two hours after sunrise.

Recognising a surface temperature inversion

A surface temperature inversion is likely to be present if:

- mist, fog, dew or a frost have occurred
- smoke or dust hangs in the air and moves sideways, just above the ground surface
- cumulus clouds that have built up during the day collapse towards evening
- wind speed is constantly less than 11 km/hr in the evening and overnight
- cool off-slope breezes develop during the evening and overnight
- distant sounds become clearer and easier to hear
- aromas become more distinct during the evening than during the day.

Spray timing

- spray during the day wherever possible. Vertical mixing of the air makes surface temperature inversions unlikely and will reduce the risk of drift caused by surface temperature inversions;

- there is a very low risk of surface temperature inversion when there is continuous overcast weather, with low and heavy cloud and/or wind speed remains above 11km/h for the whole period between sunset and sunrise;
- a lack of suitable weather conditions for spraying over extended periods
- DO NOT apply if crop or weeds are stressed due to dry or excessively moist conditions.
- DO NOT apply with spray droplets smaller than VERY COARSE spray droplets according to the ASAE S572.1 definition for standard nozzles.
- DO NOT use if rain is likely within six hours.

Monitoring and record keeping

Users of this product MUST make an accurate written record of the details of each spray application within 24 hours following application and KEEP this record for a minimum of two years. The spray application details that must be recorded are:

1. date of use with start and finish times of application;

2. the specific location which must include address and paddock/s sprayed;

3. product trade name (full name) of the product being used;

4. rate of application which must include the amount of product used per hectare and number of hectares applied to;

5. situation, crop or commodity to which the chemical was applied;

6. wind speed and direction during application;

7. air temperature and relative humidity during application;

8. nozzle brand, model, size, type, and spray system pressure measured during application;

9. height of spay boom from ground;

10. name and contact details of person applying this product (additional record keeping and/or details may be required by the state or territory where this product is used).

Regulatory Update

Watch for changes in weather conditions. Stop spraying immediately if a surface temperature inversion occurs or if spraying conditions become unsuitable for any other reason.

Division 3—Group-specific instructions applicable to a relevant 2,4-D product

- the instructions in this Division apply as a condition of use for a relevant 2,4-D product if it is a member of a group mentioned in the title of a table in this Division.

Note: The Group of which a relevant 2,4-D product is a member is set out in column 4 of the table at Part 3 of this notice.

BOOM SPRAYERS (ground application)

DO NOT apply by a boom sprayer unless the following requirements are met:

- spray droplets not smaller than a VERY COARSE (VC) spray droplet size category (minimum XC between 3 October and 15 April—advisory);
- boom heights 0.5 metres or lower above the target canopy (the higher of either the crop canopy or the targeted weeds);
- minimum distances between the application site and downwind sensitive aquatic and wetland areas including aquacultural ponds, surface streams and rivers (see Aquatic 'Downwind mandatory no-spray zone' section of the following table titled 'Buffer zones for boom sprayers') are observed;
- minimum distances between the application site and downwind sensitive crops, gardens, landscaping vegetation, protected native vegetation or protected animal habitat are observed. The buffer zones provide guidance but may not always be completely protective of all agricultural crops.

BUFFER ZONES FOR BOOM SPRAYERS:

Information on buffer zones for boom sprayers for each group is available at: https://apvma.gov.au/sites/default/files/special_gazette_01102019_0.pdf (pg11)

AERIAL APPLICATION

DO NOT apply by aerial application unless the following requirements are met:

- spray droplets not smaller than a VERY COARSE (VC) spray droplet size category;
- release heights 5 metres or lower above the target canopy;
- minimum distances between the application site and downwind sensitive aquatic and wetland areas including aquacultural ponds, surface streams and rivers are observed
- minimum distances between the application site and downwind sensitive crops, gardens, landscaping vegetation, protected native vegetation or protected animal habitat are observed. The buffer zones provide guidance but may not always be completely protective of all agricultural crops.

Information on buffer zones for aircraft for each group is available at: https://apvma.gov.au/sites/default/files/special_gazette_01102019_0.pdf (pg20)

Pasture application by air—5.0 m release height

Product Groups 1, 12, 15 (orchards), 16 (turf), 17, 20 and 21 do not contain separate pasture uses. For all other groups, rates range from 90–9000 g ae/ha. These pasture uses and application rates are highly variable between different product groups. The highest rates for individual product groups that are supported are modelled below and the corresponding buffer zones are provided for two wind speed ranges.

NOTE: some rates ARE NOT SUPPORTED for Fixed Wing aircraft and MUST NOT be applied by fixed wing aircraft

Further information on application rates are available at: Information on buffer zones for pasture application from 5.0m for each group is available at: https://apvma.gov.au/sites/default/files/special_gazette_01102019_0.pdf (pg35)

Pasture application—3.0 m release height

Product Groups 1, 12, 15 (orchards), 16 (turf), 17, 20 and 21 do not contain separate pasture uses. For all other groups, rates range from 90–9000 g ae/ha. These pasture uses and application rates are highly variable between different product groups. The highest rates for individual product groups that are supported are modelled below and the corresponding buffer zones are provided for two wind speed ranges.

NOTE: some rates ARE NOT SUPPORTED for Fixed Wing aircraft and MUST NOT be applied by fixed wing aircraft

Further information on application rates are available at: Information on buffer zones for pasture application from 3.0m for each group is available at: https://apvma.gov.au/sites/default/files/special_gazette_01102019_0.pdf (pg39)

PART 3—LABELS TO WHICH SUSPENSION DECISION APPLIES

Table 3.1: provides details of those labels that have been suspended

APVMA Special Gazette, 1 October 2019

http://www.apvma.gov.au

New scheme consultations

2019-10-04

On 1 July 2020, the Australian Industrial Chemicals Introduction Scheme (AICIS) will replace the current scheme. As with NICNAS, the costs of running AICIS will be recovered through fees and charges imposed on importers and manufacturers (introducers) of industrial chemicals. NICNAS is seeking your views on the principles and options, outlined in a newly released consultation paper, that will be used to establish fees and charges for AICIS. Feedback will be used to develop a draft Cost Recovery Implementation Statement (CRIS), which will include a proposed schedule of fees and charges for introducers under AICIS. Further information on the consultation is available at: Download consultation paper - Principles for cost recovery of AICIS [PDF 1.1 MB].

On 1 July 2020, the Australian Industrial Chemicals Introduction Scheme (AICIS) will replace the current scheme.

The consultation will close on 14 October 2019.

NICNAS, 17 September 2019

http://www.nicnas.gov.au

Malaysia pushes for strict law to police vapes, e-cigarettes

2019-10-04

Malaysia is planning to introduce strict regulations on the sale and use of electronic cigarettes and vaporisers, health officials said recently, as countries around the world move to ban devices that have been linked to deaths and youth addiction. India, which has the second-largest population of adult smokers in the world, banned the sale of e-cigarettes last month as it warned of a vaping "epidemic" among young people. Public health officials in the United States recommended against using

e-cigarettes after 12 deaths and 805 cases of illnesses linked to e-cigarette use were reported. The global market for e-cigarettes was worth $15.7 billion in 2018, according to data from Euromonitor International, and is projected to more than double to $40 billion in 2023. Malaysia wants to club e-cigarettes and vaporisers together with tobacco products under a single law that would prohibit promotions and advertising, usage in public areas and use by minors, the health ministry said. "Increasingly more studies have shown vape/electronic cigarettes ... are still harmful to human health. Furthermore, vapes/e-cigarettes are still not proven to be an effective modality to quit smoking," it said in an email. The ministry said the recent spate of deaths and illnesses linked to e-cigarette use in the United States added urgency to Malaysia's review of its policies. An estimated 5 million Malaysians aged 15 and older are smokers out of a total population of about 32 million, according to the most recent national health and morbidity survey by the health ministry in 2015. The final draft of the new Tobacco Control and Smoking Act has been completed and submitted to the attorney-general for a final review, the ministry said. "We really hope that the new Act can be tabled in parliament next year," the ministry's email said. Tobacco products in Malaysia are currently regulated under the Food Act but there are no specific regulations governing the sale and use of vaporisers and e-cigarettes. However, a ban on vaporiser liquids containing nicotine has been in place since November 2015. The world's vaping industry, which has seen rapid growth, has faced growing public backlash over concerns of increased use by young people. In a letter to the U.S. Food and Drug Administration (FDA) last month, a bipartisan group of U.S. senators urged an immediate ban on pod and cartridge-based e-cigarettes, which they say are favoured by youths, until it can be proven the products are safe. India's nationwide prohibition, the world's first, would cut off a huge future market from e-cigarette makers such as Juul Labs and Philip Morris International, which have plans to expand their operations in the country.

Reuters Health, 1 October 2019

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

Bangladesh bans heartburn drug ranitidine over cancer fears

2019-10-04

On 27 September, Bangladesh's drug regulatory authority issued a ban on sales of popular heartburn drug ranitidine while it investigates a potential cancer-causing substance in the drug. The move comes after the U.S. Food

On 27 September, Bangladesh's drug regulatory authority issued a ban on sales of popular heartburn drug ranitidine while it investigates a potential cancer-causing substance in the drug.

and Drug Administration (FDA) warned that some of the pills contained small amounts N-nitrosodimethylamine (NDMA), which the regulator says is a "probable human carcinogen". "We have banned the import of raw materials, production and sale of ranitidine until further notice," said Khandaker Sagir Ahmed, a director of Bangladesh's drug regulatory authority, adding that the decision was taken a precautionary measure. Drug manufacturers across the world have begun recalling the widely taken heartburn drug, which is sold under the trade name Zantac among others, while the FDA and European drug regulators review whether low levels of NDMA in ranitidine pose a health risk to patients. Domestic companies affected include Beximco Pharmaceuticals and Square Pharmaceuticals, which produce ranitidine under the Neoceptin R and Neotack brands respectively. The Bangladesh drug regulatory authority will test drug samples but has also asked domestic manufacturers to test their drugs in accredited labs and send reports to the watchdog, Ahmed said.

Reuters Health, 30 September 2019

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

AMERICA

Washington State Announces Interest in Restricting Chemicals in Certain Consumer Products

2019-10-04

Washington State has taken its first steps towards implementing the nation's strongest state chemicals law.

Washington State has taken its first steps towards implementing the nation's strongest state chemicals law. This month, the Department of Ecology (Ecology) announced certain chemical-product combinations that it is studying for potential priority designation. Any such designated combinations could be subject to future restrictions or bans. Stakeholders should take advantage of this early opportunity to provide input to Ecology. Ecology is seeking certain information about these chemical-product combinations, including: the concentrations of the listed chemicals found in these products; human and environmental exposure potential; availability of chemical alternatives; and volumes of these products sold in Washington. PFAS substances have been widely used in carpets for stain resistance. Ecology's focus may accelerate a move away from PFAS use in carpets. Comments may be emailed to Ecology at saferproductswa@ecy.wa.gov. Ecology plans to formally propose the first chemical-product combinations to be designated under the law by

early 2020. Following that proposal, Ecology will open a 60-day comment period.

Background

The law could impact virtually any consumer products – defined as "any item, including any component parts and packaging, sold for residential or commercial use" – that are not covered by an express exemption. Exemptions are available for inaccessible electronic components, motorized vehicles, and certain other federally-regulated products (e.g., food, drugs, and tobacco). The law could also impact the packaging of consumer products whether or not the products themselves are exempt. Before the state may restrict the use of chemicals in any consumer product or packaging, the product or packaging must be identified by Ecology as a priority product. Ecology must identify a first round of priority products by 1 June 2020. As part of its priority product selection process, Ecology may require consumer product manufacturers to disclose product or packaging composition information to the state.

Scope of Chemicals Subject to Restriction

Only chemicals designated as priority chemicals may be subject to restrictions. The law itself designates an initial list of priority chemicals:

- PFAS
- Phthalates
- Certain flame retardants
- PCBs
- Phenolic compounds

Ecology is required to designate at least five additional priority chemicals by 1 June 2024, and every five years thereafter. In selecting priority chemicals, the agency must consider potential hazards posed by a chemical, as well as its current uses in consumer products.

Restrictions and Reporting Requirements

By 1 June 2022, and every five years thereafter, Ecology must consider regulatory actions to reduce the use of priority chemicals in priority products and packaging. These regulatory actions may include restricting or prohibiting certain uses of priority chemicals, or requiring that manufacturers disclose certain uses of priority chemicals to Ecology. In deciding whether to restrict priority chemicals, Ecology must consider existing uses of a chemical, potential exposures (including exposures

to the environment, sensitive species, and subpopulations), and the availability of safer alternatives.

National Law Review, 23 September 2019

http://www.natlawreview.com

State steps closer to PFAS standards for drinking water

2019-10-04

Michigan state officials took another step toward enforceable regulations for PFAS levels in public drinking water. The Michigan PFAS Action Response Team unanimously voted to draft rules founded on the health-based values recommended by a science advisory work group nearly three months ago. It's the latest step toward state standards Gov. Gretchen Whitmer ordered be developed rather than await federal rules. Liesl Clark, director of the state Department of Environment, Great Lakes and Energy, said the suggested values on the table are "grounded in science." PFAS is an acronym for a family of man-made per- and polyfluoroalkyl chemicals, now considered a worldwide emerging contaminant after decades of common use of the substances in a vast variety of products, including in military, industrial and manufacturing processes. Eric Oswald, director of EGLE's drinking water and environmental health division, said state officials are on schedule to meet Whitmer's 1 October deadline for draft regulations. The proposed rules outline how public water supply compliance will be based on annual average PFAS levels based on quarterly sampling, and there is a public notice requirement for failures, Oswald said. Additionally, he said the proposed rules would not apply to private residential water wells, nor to locations that don't provide long-term water supplies such as small businesses, campgrounds, highway rest areas and the like. Oswald said EGLE officials will present the draft PFAS drinking water regulations to the agency's Environmental Rules Review Committee on Oct. 3 and the members of that group are scheduled to vote 31 October about whether to sign off on the ongoing rule-making process so it can continue. Should that happen, he said public hearings will begin to be scheduled in November or December. Steve Sliver, MPART's executive director, said this whole process is unusual because normally Michigan officials adopt standards set by the U.S. Environmental Protection Agency. Those are slow in coming. Clark said EPA regulators are well aware that not only Michigan officials but those from other states also want to see federal standards set for PFAS levels in drinking water. But Michigan is moving forward anyway, she said. The EPA established a non-binding advisory level of 70 parts per trillion for two of the thousands of chemicals, PFOA and PFOS. Other

Michigan state officials took another step toward enforceable regulations for PFAS levels in public drinking water.

states set more stringent levels. Minnesota, New Jersey and New York have lower established or proposed thresholds for PFOS at 15 ppt, 13 ppt and 10 ppt, respectively. But Michigan stands to have the lowest numbers for PFOA at 8 ppt and PFNA at 6 ppt, should those recommendation levels be finalised. The recommended PFAS levels weren't approved for continued rule-making without some dispute during Friday's MPART meeting. Anna Reade, staff scientist with the non-profit Natural Resources Defence Council, spoke about that organisation's recommendation that Michigan officials reconsider a treatment-based water standard for drinking water systems with detectable PFAS. Instead, it's preferred a focus be placed on treatments that would affect broader numbers of PFAS chemicals, of which there are thousands. "Regulating PFAS as a class is tremendously hard, but I think we are missing an opportunity to move the ball forward," she said. Reade said continued focus on individual PFAS chemicals leads to underestimates of the real effects occurring in human bodies. PFAS chemicals bioaccumulate in living organisms. The NRDC scientist and another official from that group submitted to MPART a letter that made those arguments, also signed by two Sierra Club officials. Liz Kirkwood, executive director of Traverse City-based non-profit For Love of Water, said she agrees with officials from those environmental non-profits about rules being needed for the entire class of PFAS chemicals. "The health-based values the state derived through scientific work is important but doesn't fully recognise class-based regulation and the cumulative effects of multiple PFAS chemicals over a lifetime of exposure," she said. Kirkwood said regulations based on class-wide standards would be ideal because otherwise officials will have to continually amend the rules. Also, she said since Michigan is on the forefront of identifying PFAS contamination sites, it might also want to be on the cutting edge of regulated drinking water limits for the emerging contaminant. "We do not want to be the lowest common denominator. We want to set the bar high for other states to duplicate," Kirkwood said. More information about PFAS in Michigan and the state's response is available at www.michigan.gov/pfasresponse online.

Record Eagle, 28 September 2019

https://www.record-eagle.com/

The United States Environmental Protection Agency lacks pigment violet 29 toxicity data, peer reviewers say

Regulatory Update

US EPA lacks pigment violet 29 toxicity data, peer reviewers say

2019-10-04

The United States Environmental Protection Agency has presented insufficient information to conclude that pigment violet 29 (PV29)—a colorant used in paints, plastics, and other products—poses "no unreasonable risk" to human health and the environment, an external advisory committee says. In a final report released on Sept. 20, the committee points out numerous data deficiencies in the EPA's draft risk assessment of PV29, including a lack of solubility studies, workplace air-monitoring data, and inhalation and dermal toxicity information. The substance is one of 10 chemicals that the EPA must evaluate by the end of the year under the Toxic Substances Control Act. Environmental groups have also submitted comments to the agency expressing similar concerns about the agency's failure to request additional toxicity data from PV29 manufacturers. "EPA has fallen far short of supporting its sweeping conclusion that the chemical does not present unreasonable risk, including to vulnerable subpopulations," Richard Denison, a lead senior scientist at the Environmental Defence Fund, says in a recent blog post. It is unclear whether the agency will follow the committee's advice, which is not legally binding.

Chemical & Engineering News, 27 September 2019

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

U.S. Department of Labor Proposes Revisions to OSHA's Beryllium

2019-10-04

The United States Department of Labor's Occupational Safety and Health Administration (OSHA) has finalised its 27 June 2017, proposal to revise the construction and shipyards standards. In the final rule, to be published on 30 September 2019, OSHA:

- Does not implement the proposal to revoke all of the standards' ancillary provisions; but
- Extends the compliance dates for the ancillary provisions to September 2020 to account for OSHA's new proposal to revise or remove specific provisions; and
- Maintains enforcement of the permissible exposure limit.

The United States Department of Labor's Occupational Safety and Health Administration (OSHA) has finalised its 27 June 2017, proposal to revise the construction and shipyards standards.

Regulatory Update

In a forthcoming rulemaking, OSHA will publish a proposal to amend the beryllium standards for construction and shipyards by more appropriately tailoring the requirements of the standards to the exposures in these industries. The proposed changes would maintain safety and health protections for workers, facilitate compliance with the standards, and increase cost savings.

U.S OSHA, 27 September 2019

http://www.osha.gov

EUROPE

European Chemicals Agency proposes tight controls for uses of BPA, dechlorane plus, and two glycol ethers

2019-10-04

The European Chemicals Agency (ECHA) is proposing strict regulation of many uses of bisphenol A (BPA), the flame retardant dechlorane plus, two glycol ethers, and several metal-containing compounds. If the European Commission concurs with this plan, which ECHA released 1 October, companies in most cases will be prohibited from using the substances unless they apply for and receive authorization from ECHA to do so. However, the proposal on would not affect use of BPA, an estrogenic compound, in the manufacture of materials such as polycarbonate. ECHA classifies BPA as toxic for reproduction. The proposal would tightly control use of dechlorane plus, a polychlorinated flame retardant used in adhesives, sealants, polymers, computers, electronics, and vehicle textiles. ECHA deems this substance as very persistent and very bioaccumulative. ECHA considers ethylene glycol monoethyl ether and ethylene glycol monomethyl ether to be toxic for reproduction. The proposal would require authorisation for uses of these substances other than as intermediates in making other materials. The proposal also covers 9 substances that contain lead or tin and are also considered toxic for reproduction. They include tetraethyl lead used as an additive in aviation fuel. The proposal would not impact fuel that contains less than 0.1% of this substance.

The European Chemicals Agency (ECHA) is proposing strict regulation of many uses of bisphenol A (BPA), the flame retardant dechlorane plus, two glycol ethers, and several metal-containing compounds.

Chemical& Engineering News, 2 October 2019

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

Regulatory Update

Bees and pesticides: second consultation begins on guidance review

2019-10-04

The European Food Safety Authority (EFSA) is carrying out a second stakeholder consultation in support of the review of its guidance on pesticides and bees. The dedicated stakeholder consultation group has been asked to comment on the protocol that EFSA will use to collect and evaluate data on bee mortality. The need for up-to-date evidence on bee mortality – taking account of realistic beekeeping management and natural background mortality – was highlighted by the European Commission when it asked EFSA to review the guidance. The consultation group has already provided comments on the current guidance, which was published in 2013. Pesticide experts in EU Member States have also been consulted on the current document. The feedback will be considered by the scientific working group set up to review the guidance at its first meeting next week. EFSA will continue to consult stakeholders and Member State experts throughout the process. A full public consultation and workshop will take place when the guidance document has been drafted. Further information is available at: Outline of the revision of the guidance on the risk assessment of plant protection products and bees

EFSA, 26 September 2019

http://www.efsa.europa.eu

The European Food Safety Authority (EFSA) is carrying out a second stakeholder consultation in support of the review of its guidance on pesticides and bees.

ECHA Will Hold November Webinar on Updated REACH Information Requirements for Nanoforms

2019-10-04

On12 November 2019, the European Chemicals Agency (ECHA) will hold a webinar on the amended information requirements for nanoforms under the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) regulation. The European Commission (EC) announced on 3 December 2018, that it adopted amendments to several REACH Annexes to clarify the information requirements for nanomaterials. The amended requirements will apply beginning 1 January 2020. The European Chemicals Agency (ECHA) states that the updated Annexes introduce new concepts: nanoform and a set of similar nanoforms. The updated REACH Annex VI also defines specific characterisation parameters for the nanoforms of substances. The first part of the 12 November 2019, webinar will explain what a nanoform is and how to build a set of similar nanoforms. It will also explain how to fulfil data requirements for

the characterisation of nanoforms. The second part will introduce new International Uniform Chemical Information Database (IUCLID) fields for reporting the characterisation parameters of nanoforms and give some practical examples on how to use the different fields. Attendees will also have the chance to ask questions from ECHA's experts.

Nano & Other Emerging Technologies Blog

http://nanotech.lawbc.com

REACH Update

ECHA proposes 18 substances for authorisation

2019-10-03

The European Chemicals Agency's (ECHA) ninth recommendation to the European Commission to prioritise substances of very high concern for authorisation includes 18 substances. Thirteen of these substances are toxic for reproduction, of which one has also endocrine disrupting properties. The other substances are an endocrine disruptor, a carcinogen, a very persistent and very bioaccumulative (vPvB) substance and two respiratory sensitisers. The substances have been prioritised from the Candidate List because of their intrinsic properties in combination with high volume and widespread uses, which may pose a threat to human health or the environment. Some of these substances are currently not used in the EU but could replace other substances recommended for the Authorisation List (Annex XIV). Their inclusion should avoid regrettable substitution. ECHA organised a public consultation on the draft recommendation between September and December 2018. The Member State Committee (MSC) considered the comments received and adopted its opinion on 26 June 2019. ECHA took into account the comments and registration updates as well as the MSC's opinion when deciding on the substances now recommended to be added to the REACH Authorisation List and for proposing the related latest application and sunset dates. All substances that underwent public consultation are included in the final recommendation. The final decision on the inclusion of the substances in the Authorisation List and on the dates by which companies will need to apply for authorisation to ECHA will be taken by the European Commission in collaboration with the Member States and the European Parliament. Further information is available at:

18 substances of very high concern (SVHCs) are recommended to be added to the REACH Authorisation List.

- List of substances included in the ninth recommendation, including examples of their uses in the scope of authorisation (Annex)
- Ninth recommendation
- Details on the substances under Submitted recommendations

ECHA, 1 October 2019

http://echa.europa.eu

REACH Update

New version of EUSES tool helps companies assess biocides

2019-10-03

The update of the European Union System for the Evaluation of Substances (EUSES) revives a tool that has been available since the 1990s, but not maintained since 2012. It will help companies and authorities assess the environmental impact of biocidal active substances. The new version aims to address the immediate needs of companies and authorities performing environmental risk assessment for biocides. New and updated emission scenarios developed since 2012 for biocides have been added to the tool. EUSES users in industry and Member States can assess active substances in 18 biocidal product-types. For two product-types – veterinary hygiene and insecticides – missing emission scenarios will be made available as separate tools on ECHA's website. The emission pathway of direct release to the environment has been included in EUSES throughout all the assessment steps. A new version of the SimpleTreat model (4.0), which assesses the fate and distribution of a substance in a sewage treatment plant, has also been added. The update focuses solely on biocides. For REACH, companies can also use the Chemical Safety Assessment and Reporting tool (Chesar). In the long term, ECHA is looking to develop a central tool to harmonise chemical risk assessment for REACH and biocides. Further information is available at:

- Download EUSES
- Practical guide: How to use EUSES 2.2.0
- Webinar: New features of EUSES 2.2.0
- EUSES software will help you assess biocides
- Release note

ECHA, 1 October 2019

http://echa.europa.eu

The update of the European Union System for the Evaluation of Substances (EUSES) revives a tool that has been available since the 1990s, but not maintained since 2012.

Commission proposes to improve the compliance of chemical registration dossiers with EU law

2019-10-03

Recently, the Member States in the REACH Committee agreed unanimously to a Commission proposal amending the compliance check target of registration dossiers in REACH from 5% to 20%. The Commission can proceed to adoption after a scrutiny period by the European Parliament and the Council of 3 months. REACH is the most

REACH Update

comprehensive chemical legislation in the world. Over the past 10 years, the EU has significantly reduced citizens' exposure to harmful chemicals by requiring data from industry to demonstrate the safe use of chemicals in a registration dossier. Industry submitted more than 90,000 dossiers, however, in about 1/3 of the dossiers checked by the European Chemicals Agency (ECHA), the information did not meet the requirements specified in REACH. Therefore, the Commission and ECHA developed an Evaluation Action Plan, with the increase of dossiers checked for compliance as the first action. ECHA may examine any registration dossier to verify if the information submitted by registrants is compliant with the legal requirements. Compliance checks evaluate the substance identity description, safety information related to human health and the environment. According to REACH, ECHA currently must check at least 5% of the registration dossiers of each tonnage band. To encourage dossier compliance, the Commission is proposing to raise the minimum target for compliance checks to 20%. Member States in the REACH Committee agreed to the proposal unanimously. After a scrutiny period of 3 months by the European Parliament and the Council, the Commission can adopt the proposal. Compliance checks focus (not exclusively) on 8 key endpoints: genotoxicity, repeated-dose toxicity, pre-natal developmental toxicity, reproduction toxicity, carcinogenicity, long-term aquatic toxicity, biodegradation and bioaccumulation. They are key endpoints for identifying substances of concern and concluding whether the criteria for substances of very high concern are likely to be fulfilled.

Under the new minimum target, ECHA aims to check 20% of dossiers for substances registered in very high volumes (over 100 tonnes per year) by 2023, and 20% of dossiers for substances registered in lower volumes (1-100 tonnes per year), covering approximately 30% of all registered substances by 2027. The Evaluation Action Plan outlines the comprehensive strategy under which ECHA is screening all registration dossiers, proceeding directly with the development of further risk management measures where appropriate and launching compliance checks for those substances for which it considers that more information is needed. Companies need to regularly review their registration dossiers and update them when necessary. The Commission is preparing an implementing regulation to further specify by which timelines the updates should be made. In addition, and based on ECHA's experience, the Commission works on clarifying certain REACH information requirements to facilitate industry compliance and evaluation procedures, to be discussed at the REACH Committee before the end of this year. Finally, enforcement is of course of utmost importance. This is the responsibility

of Member States and is coordinated at EU level through the 'Forum for Enforcement'.

European Commission, 20 September 2019

http://europa.eu/index_en.htm

Submission of lead chromates restriction report postponed

2019-10-03

The submission of the Annex XV restriction report on lead chromate; lead sulfochromate yellow (C.I. Pigment Yellow 34) and lead chromate molybdate sulphate red (C.I. Pigment Red 104) by ECHA has been postponed to 17 January 2020. Further information is available at: Registry of restriction intentions

ECHA News, 2 October 2019

http://echa.europa.eu

Mutagenicity: updated recommendations to registrants

2019-10-03

The European Chemicals Agency (ECHA) has updated its recommendations to registrants on mutagenicity. A germ cell genotoxicity study may be required under certain circumstances. Take a look at ECHA's recommendations on how to improve registration dossiers under the section "Toxicological properties" here.

ECHA News, 2 October 2019

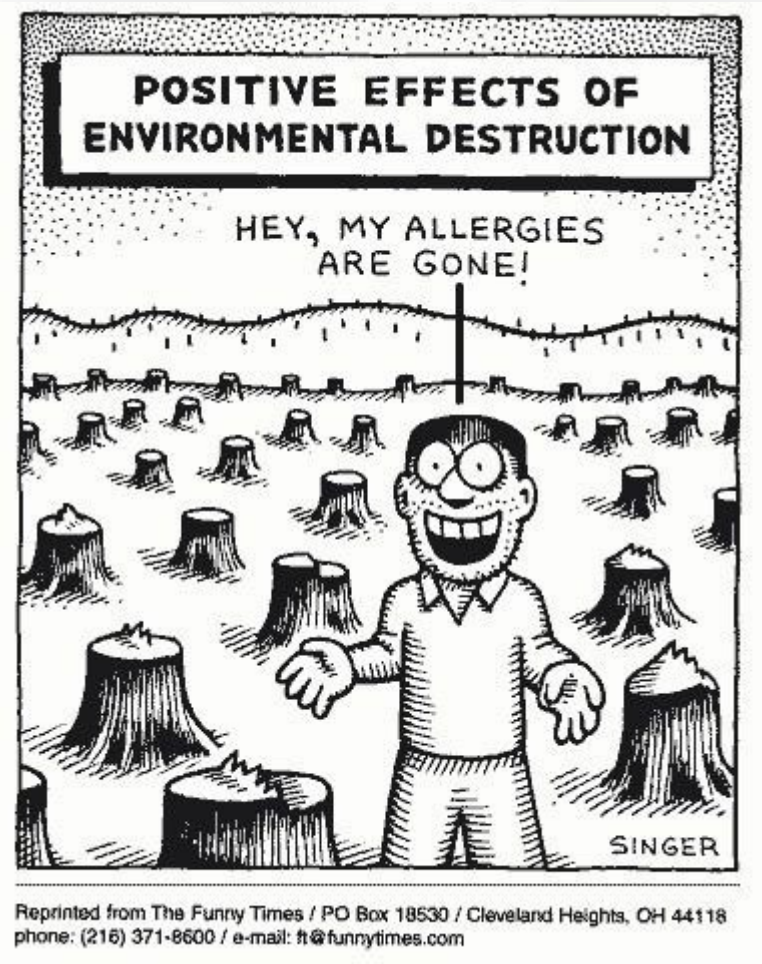
http://echa.europa.eu

The submission of the Annex XV restriction report on lead chromate; lead sulfochromate yellow (C.I.

Janet's Corner

Positive Effects of Environmental Destruction

2019-10-04



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phone: (216) 371-8600 / e-mail: ft@funnytimes.com

Hazard Alert

Arsine

2019-09-21

Arsine is an inorganic compound with the formula AsH_3. This flammable, pyrophoric, and highly toxic gas is one of the simplest compounds of arsenic. [1] Arsine has a garlic-like or fishy odour that can be detected at concentrations of 0.5 ppm and above. Because arsine is non-irritating and produces no immediate symptoms, persons exposed to hazardous levels may be unaware of its presence. Arsine is water soluble. [2] Arsine is formed when arsenic comes in contact with an acid. [3]

USES [2,3]

Arsine is used as a doping agent in the semiconductor industry and in the manufacture of crystals for fiberoptics and computer chips. It is used infrequently in galvanizing, soldering, etching, burnishing, and lead plating. It was also investigated as a warfare agent during World War II, but it was never used on the battlefield.

SOURCES & ROUTES OF EXPOSURE

Sources of Exposure [2]

Arsine gas is formed when arsenic-containing materials react with freshly formed hydrogen in water or acids. Exposure may result when arsenic containing metals (i.e., metal vats) undergo acid washes. Unintentional exposures have also occurred during refining of ores (e.g., lead, copper, zinc, iron, and antimony ores) that contain arsenic.

Routes of Exposure [2]

- Inhalation is the major route of exposure. The odour threshold of arsine is 10-fold greater than the Occupational Safety and Health Administration (OSHA) permissible exposure limit. Odour is not an adequate indicator of arsine's presence and does not provide reliable warning of hazardous concentrations. Arsine is heavier than air and hazardous concentrations may develop quickly in enclosed, poorly ventilated, or low-lying areas.
- Skin/Eye Contact: There is little information about direct toxic effects of arsine on the skin or eyes, or about absorption through the skin. Exposure to liquefied arsine (the compressed gas) can result in frostbite.

- Ingestion of arsine itself is unlikely because it is a gas at room temperature. However, metal arsenides are solids that can react with acidic gastric contents, releasing arsine gas in the stomach.

HEALTH EFFECTS [2]

Acute Exposure

After absorption by the lungs, arsine enters red blood cells (RBC) where different processes may contribute to haemolysis and impairment of oxygen transport. Inhibition of catalase may lead to accumulation of hydrogen peroxide which, as an oxidiser, destroys red cell membranes and may contribute to arsine-induced conversion of Fe+2 to Fe+3, which also impairs oxygen transport. Arsine preferentially binds to haemoglobin, and is oxidised to an arsenic dihydride intermediate and elemental arsenic, both of which are haemolytic agents. Arsine toxicity involves depletion of reduced glutathione. Therefore, people deficient in the enzyme glucose-6-phosphate-dehydrogenase (G6PD) are more susceptible to haemolysis following arsine exposure. Pre-existing cardiopulmonary or renal conditions, iron deficiency, and/or pre-existing anaemia may result in more severe outcomes if haemolysis occurs. Contact with the skin or eyes is not expected to result in systemic toxicity. Ingestion of arsine is unlikely, but ingestion of metallic arsenides can lead to arsine gas production and toxicity.

Haematologic

Acute intravascular haemolysis develops within hours and may be severe during the first 2 or 3 days following exposure. Free haemoglobin levels in plasma rise (levels greater than 2 g/dL have been reported). Anaemia ensues subsequent to haemolysis. Anaemia may develop quickly and be severe. Leukocytosis and signs of intravascular coagulation can be observed during the haemolytic phase. Methemoglobinaemia can be of concern in infants and toddlers. Children may be more vulnerable to loss of effectiveness of haemoglobin because of their relative anaemia compared to adults.

Respiratory

A garlic odour may be present on the breath. Delayed accumulation of fluid in the lungs may occur after massive exposure. Dyspnoea may be due to lack of oxygen secondary to haemolysis. Children may be more vulnerable to gas exposure because of relatively higher minute ventilation

per kg and failure to recognise the need to promptly evacuate an area when exposed.

Renal

Kidney failure due to acute tubular necrosis is a significant sequela of arsine exposure. Haemoglobin in the urine is thought to be the major cause of damage to the kidneys; however, a direct toxic effect of arsine or deposition of the arsine-haemoglobin-haptoglobin complex may also play a role. Urinalysis shows large amounts of protein and free haemoglobin usually without intact RBCs. Urine may be unusually coloured (e.g., brown, red, orange, or greenish). Decreased urinary output may develop within 24-48 hours.

Gastrointestinal

Nausea, vomiting, and crampy abdominal pain are among the first signs of arsine poisoning. Onset varies from a few minutes to 24 hours after exposure.

Dermal

The characteristic bronze tint of the skin caused by arsine toxicity is induced by haemolysis and may be caused by haemoglobin deposits. The bronze coloration is not jaundice, although jaundice may develop later as a result of significant haemolysis. Contact with liquefied arsine (compressed gas) can cause frostbite.

CNS

Headache is often an early sign of exposure. CNS disorders can develop several days after severe exposure; signs include restlessness, memory loss, disorientation, and agitation. Some exposed persons experience signs of peripheral nerve damage 1-2 weeks after exposure. There are case reports of polyneuropathy developing 1-6 months after arsine exposure.

Hepatic

Right upper quadrant pain, hepatomegaly, elevated serum globulin, elevated liver enzymes and prolonged prothrombin time have been observed.

Musculoskeletal

Skeletal muscle injury or necrosis have been reported. Muscle pain and twitches, myoglobinuria, elevated levels of serum creatine phosphokinase (CPK), and aldolase have been observed.

Cardiovascular

Cardiovascular effects may include moderate and transient sinus tachycardia secondary to haemolysis or anaemia, hypovolemia or acute pulmonary oedema, hypotension and cardiovascular shock due to direct effects on the myocardium and hyperkalaemia, elevation of the T-wave (ECG) and various degrees of heart block, and general vasoconstriction due to peripheral hypoxia.

Ophthalmic/Ocular

Watery eyes, photophobia, blurred vision, and red staining of the conjunctiva may appear early after exposure.

Chronic Exposure

Chronic arsine exposure can result in gastrointestinal upset, anaemia, and damage to lungs, kidneys, liver, nervous system, heart, and blood-forming organs. There is little information regarding health effects of chronic low-level exposures to arsine.

Carcinogenicity

There are no data on the carcinogenicity of arsine in humans or in experimental animals. However, arsine is oxidised to the same trivalent and pentavalent forms of arsenic as those seen after drinking-water or inhalation exposure to arsenic compounds known to present a cancer hazard. The Department of Health and Human Services (DHHS), the International Agency for Research on Cancer (IARC), and the Environmental Protection Agency (EPA) have classified inorganic arsenic as a human carcinogen based on sufficient evidence from human data.

Reproductive and Developmental Effects

Arsine should be treated as a potential teratogenic agent. Although the reproductive effects of acute or chronic exposure to arsine are unknown, some related inorganic arsenicals produce a broad spectrum of adverse developmental effects in animals. Animal studies indicated that in arsine-exposed mothers, arsenic crosses the placenta and reaches the foetus; however, no adverse developmental effects were observed.

Hazard Alert

SAFETY [5]

First Aid Measures

- Inhalation: Immediately remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, qualified personnel may give oxygen. Call a physician. Symptoms may be delayed. Consider any exposure as a potentially toxic dose.
- Skin contact: Adverse effects not expected from this product. The liquid may cause frostbite. For exposure to liquid, immediately warm frostbite area with warm water not to exceed 105°F (41°C). Water temperature should be tolerable to normal skin. Maintain skin warming for at least 15 minutes or until normal colouring and sensation have returned to the affected area. In case of massive exposure, remove clothing while showering with warm water. Seek medical evaluation and treatment as soon as possible.
- Eye contact: Immediately flush eyes thoroughly with water for at least 15 minutes. Hold the eyelids open and away from the eyeballs to ensure that all surfaces are flushed thoroughly. Contact an ophthalmologist immediately.
- Ingestion: Ingestion is not considered a potential route of exposure.

Fire Information

- Arsine is a toxic, flammable liquefied gas.
- Vapour forms explosive mixtures with air and oxidising agents.
- If leaking gas catches fire, do not extinguish flames.
- Flammable and toxic vapours may spread from leak and could explode if reignited by sparks or flames.
- Vapours are heavier than air and may collect in low spots. Explosive atmospheres may linger.
- Evacuate all personnel from the danger area. Use self-contained breathing apparatus (SCBA) and protective clothing.
- Immediately cool containers with water from maximum distance.
- Stop flow of gas if safe to do so, while continuing cooling water spray.
- Remove ignition sources if safe to do so.
- Remove containers from area of fire if safe to do so.

Exposure Controls and Personal Protection

Engineering Controls

- Use an explosion-proof local exhaust system.
- Local exhaust and general ventilation must be adequate to meet exposure standards.
- Use explosion proof equipment and lighting.

Personal Protective Equipment

The following personal protective equipment is recommended when handling arsine:

- Hand protection: Neoprene rubber.
- Eye protection: Wear safety glasses when handling cylinders; vapour-proof goggles and a face shield during cylinder change out or whenever contact with product is possible. Select eye protection in accordance with OSHA 29 CFR 1910.133.
- Skin and body protection: Wear metatarsal shoes and work gloves for cylinder handling, and protective clothing where needed. Wear appropriate chemical gloves during cylinder change out or wherever contact with product is possible. Select per OSHA 29 CFR 1910.132, 1910.136, and 1910.138.
- Respiratory protection: When workplace conditions warrant respirator use, follow a respiratory protection program that meets OSHA 29 CFR 1910.134, ANSI Z88.2, or MSHA 30 CFR 72.710 (where applicable). Use an air-supplied or air-purifying cartridge if the action level is exceeded. Ensure that the respirator has the appropriate protection factor for the exposure level. If cartridge type respirators are used, the cartridge must be appropriate for the chemical exposure (e.g., an organic vapour cartridge). For emergencies or instances with unknown exposure levels, use a self-contained breathing apparatus (SCBA).
- Thermal hazard protection: Wear cold insulating gloves when transfilling or breaking transfer connections.

REGULATION [6]

United States

OSHA: The United States Occupational Safety & Health Administration has set the following Permissible Exposure Limits (PEL) for arsine of:

- General Industry: 29 CFR 1910.1000 Z-1 Table -- 0.05 ppm, 0.2 mg/m3 TWA
- Maritime: 29 CFR 1915.1000 Table Z-Shipyards -- 0.05 ppm, 0.2 mg/m3 TWA

ACGIH: The American Conference of Governmental Industrial Hygienists has set a Threshold Limit Value (TLV) for arsine of 0.005 ppm, 0.016 mg/m3 TWA

NIOSH: The National Institute for Occupational Safety and Health has set a Recommended Exposure Limit (REL) for arsine of 0.002 mg/m3 Ceiling (15 min); Potential Carcinogen

Australia

Safe Work Australia: Safe Work Australia has established a Time Weighted Average Concentration for arsine of 0.05 ppm, 0.16 mg/m3 for a 40-hour work week.

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Gossip

Synthesis of hindered dialkyl ethers shocked into new life

2019-09-24

Hindered ethers are tricky little buggers. They're important precursors for many products, especially in the synthesis of certain drugs. The bulkiness of the compounds help prevent the body's enzymes from metabolising the drug molecule before it reaches its target. But this bulkiness also means the compounds are hard to make. Now Phil Baran of the Scripps Research Institute California and co-workers have resurrected an old electrochemical method to zap new life into hindered dialkyl ether synthesis, making 80 different ethers through zippier routes while also boosting yields (Nature 2019, DOI: 10.1038/s41586-019-1539-y). Traditionally, chemists make ethers using the Williamson synthesis, which involves an oxygen nucleophile attacking a carbon centre to kick off a leaving group through an SN2 type mechanism. In the case of hindered ethers, bulky groups on the attacking nucleophile get in the way and slow down the reaction and cut yields. Baran's team wanted to find a faster route to hindered ethers and decided to try the Hofer-Moest reaction. This electrocatalytic method was first published in 1902 and involves using an electric potential to drive the decarboxylation of a carboxylic acid, producing a carbocation that an alcohol nucleophile can then attack. However, this reaction normally uses solvent quantities of the alcohol nucleophile, which can lead to generation of a lot of side products, such as alkynes from radical addition reactions, carbenes from elimination, and alcohols from hydration. Baran's team could use less nucleophile and avoid side reactions by tweaking the electrode material and solvent used, as well as adding small amounts of sacrificial oxidants to prevent radicals in the solution from degrading the carbocation. The key was to make the carbocation long-lived so the small amounts of bulky nucleophile had time to react with it. In the previous version of the reaction, the carbocation "was living in a sea of nucleophiles waiting to attack it, like a steak thrown on a hoard of angry wolves," Baran says. "In this case we basically had a carbocation sitting in a huge warehouse where in the corner maybe there was one puppy." The group ran over 1,000 reactions to optimise the reaction conditions and ended up making over 80 compounds (example shown). The new method had average yields around 43% and average reaction times of 9.8 hours. The older Williamson-based methods had average yields around 19% and took about 100 hours of reaction time. The team found that simple nucleophiles can also easily grab the carbocations, making hindered alcohols and alkyl fluorides, two other commercially important compounds. The method also tolerated a

Rethinking an old electrochemical method boosts yields of the bulky compounds and lowers reaction times

variety of more complex nucleophiles typically known for being sensitive to harsh reaction conditions, including some protected amines, acetals, and boronic esters. The versatility of the reaction is really what's important here, Baran says. For medicinal chemists, being able to apply similar methods to synthesize a variety of different molecules is essential. "They want to take modules of a thousand pieces of one thing and a thousand pieces of another thing and put them together and mix and match," he says. "This method gives you the modularity." For this work, Baran collaborated with industrial chemists from both Bristol-Myers Squibb and Pfizer. "I think this is going to be something that pharmaceutical companies and medicinal chemists are going to pick up and use right away," says Song Lin, an organic electrochemist at Cornell University. Baran and others, he says, have shown that chemists "can use the generic features of electrochemistry to power organic reactions."

Chemical & Engineering News, 11 September 2019

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

Chemical companies spar over PFAS pollution liability in US

2019-09-24

DuPont, Chemours, and 3M just say no to broad clean-up responsibility

Executives from DuPont, Chemours, and 3M told Congress at a 10 September hearing that their companies should not be held liable for widespread per- and polyfluoroalkyl substances (PFAS) pollution across the US. DuPont spun off its fluorochemicals business into Chemours in 2015. As part of that move, DuPont believes that financial responsibility for decades of previous PFAS production also went to Chemours, said Daryl Roberts, DuPont's chief operations and engineering officer. Chemours has adequate financial resources to foot the bill, Roberts said. A Chemours executive said his company doesn't have that money. Reiterating Chemours's argument in a recently filed lawsuit, Paul Kirsch, the company's president of fluoroproducts, said DuPont grossly underestimated the PFAS liabilities the spinoff inherited. Chemours wants DuPont to pony up money for clean-up. And a vice president for 3M, which formerly manufactured two of the main PFAS tainting drinking water supplies across the US, said neither of those chemicals is causing adverse health effects in the general population. "The data simply don't show any cause and effect relationships at historical levels of these materials in the environment," said Denise R. Rutherford, 3M senior vice president of corporate affairs. The two substances that 3M voluntarily took off the market about two decades ago are perfluorooctanoic acid (PFOA) and perfluorooctanesulfonic acid

(PFOS). The US Environmental Protection Agency says both chemicals can cause reproductive, developmental, liver, kidney, and immunological effects in laboratory animals, and both led to tumors in animal studies. Epidemiology studies have found increased levels of cholesterol among people exposed to the substances. Toxicologists are investigating whether exposure to the chemicals reduces the body's immune response (Crit. Rev. Toxicol., 2018, DOI: 10.1080/10408440802209804). Meanwhile, hundreds of drinking water sources in the US are contaminated with PFAS. A number of states have regulated the amount of PFOS, PFOA, and, in some cases, other PFAS allowed in drinking water. The EPA is considering nationwide limits. At the hearing, members of the House of Representatives' Oversight and Reform Subcommittee on Environment tried to determine who will foot the bill for cleaning PFAS pollution. Democratic lawmakers expressed frustration at the companies' unwillingness to take responsibility for the pollution. "This is ridiculous," Rep. Dan Kildee (D-MI) said. "We have companies that have benefited and made millions and billions of dollars by selling these products into commerce who now want to point the finger at somebody else." As for 3M, "You want to get credit for the decision to no longer produce these dangerous chemicals voluntarily but in the same breath want us to believe that there's no science that says that these chemicals are dangerous at all," Kildee said to Rutherford. In Kildee's district, Michigan has issued do not eat warnings for fish from the Huron River and deer from near a closed Air Force base because of high levels of PFOS. DuPont's Roberts and 3M's Rutherford said PFOS and PFOA are no longer sold because they are biopersistent. The executives were otherwise silent on the issue of toxicity. Two lawyers who led successful litigation against 3M and the original incarnation of DuPont told lawmakers that both companies were aware for years that PFOS and PFOA were hazardous to health. "Public records and public trial exhibits in the lawsuit show that 3M knew but concealed the dangers of these chemicals for decades," said Lori Swanson, former attorney general of Minnesota. Swanson filed suit against 3M in 2010 seeking clean-up of PFAS from the company's operations in the state. 3M settled the suit last year. Rep. Katie Hill (D-CA) pressed the chemical company executives about PFAS liability. "Who is going to pay for the injuries and the clean-up these companies or the taxpayers?" she asked, noting that Chemours did not exist when much of the current PFAS contamination occurred. "We don't believe the taxpayers should pay," DuPont's Roberts responded, adding that his company is cleaning up PFAS at three facilities it still owns. "What these companies have done is deeply immoral and shameful," said subcommittee chair

Harley Rouda (D-CA), who has convened three hearings on PFAS pollution this year.

Chemical & Engineering News, 11 September 2019

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

Better Device Tracking With WiFi Could Help Indoor Navigation

2019-09-24

A new technique uses a novel combination of WiFi signals and accelerometer technology to track devices in near-real time, researchers report. The technique, which can measure speed and distance in indoor environments, could help improve navigation technologies for robots, drones, or pedestrians trying to find their way around an airport. "We call our approach WiFi-assisted Inertial Odometry (WIO)," says co-corresponding author Raghav Venkatnarayan, a PhD student at North Carolina State University. "WIO uses WiFi as a velocity sensor to accurately track how far something has moved. Think of it as sonar, but using radio waves, rather than sound waves." Many devices, such as smartphones, incorporate technology called inertial measurement units (IMUs) to calculate how far a device has moved. However, IMUs suffer from large drift errors, meaning that even minor inaccuracies can quickly become exaggerated. In outdoor environments, many devices use GPS to correct their IMUs. But this doesn't work in indoor areas, where GPS signals are unreliable or non-existent. "We created WIO to work in conjunction with a device's IMU, correcting any errors and improving the accuracy of speed and distance calculations," says co-corresponding author Muhammad Shahzad, an assistant professor of computer science. "This improvement in accuracy should also improve the calculations regarding a device's precise location in any indoor environment where there is a WiFi signal." The researchers wanted to test the WIO software but ran into a problem: they could not access the WiFi network interface cards in off-the-shelf devices such as smartphones or drones. To address the problem, the researchers created a prototype device they could use in conjunction with other devices. The researchers found that using WIO improved a device's speed and distance calculations dramatically. For example, devices using WIO calculated distance with a margin of error ranging from 5.9% to 10.5%. Without WIO, the devices calculated distance with a margin of error from 40% to 49%. "We envision WIO as having applications in everything from indoor navigational tools to fitness tracking to interactive gaming," Venkatnarayan says. "We are currently working with Sony to further

A new technique uses a novel combination of WiFi signals and accelerometer technology to track devices in near-real time, researchers report.

improve WIO's accuracy, with an eye toward incorporating the software into off-the-shelf technologies," says Shahzad. The researchers will present their paper on the work at UbiComp 2019 in London, UK.

Futurity, 13 September 2019

http://www.futurity.org

Tracking down arsenic in drinking water

2019-09-24

On any given day, 140 million people in 70 countries are drinking water that is contaminated with arsenic at levels above the World Health Organization safety threshold of 10µg/l. This makes the known carcinogen the most significant chemical contaminant in drinking water globally. The problem is particularly pressing in Bangladesh, where as many as 70 million people are affected and one in five deaths is attributed directly to arsenic contamination. Arsenic occurs naturally in groundwater, dissolving out of arsenic-containing minerals in the bedrock. The scale of the crisis makes Bangladesh the priority destination for spin-out company AquAffirm, which is about to introduce a rapid, easy-to-use test for arsenic contamination in water. The product came together in an unusual way, says David Sarphie, AquAffirm's chief executive. It has its roots in a goldmine in northern Australia, where Joanne Santini from University College London, UK, discovered a bacterium that metabolises arsenite. 'These bacteria were surviving in arsenic-laden rock in a goldmine where nothing should have been alive,' Sarphie says. 'But there they were, so [Santini] collected them and after a number of years she was able to determine the enzyme that enabled the bacteria to survive in such an environment.' Santini also developed a low-cost method for producing the enzyme in the lab. Later, she crossed paths with Tony Cass from Imperial College London, UK, who is best known for his role in developing the electronic finger-prick glucose monitor for diabetes. Cass developed a process to attach the enzyme to a sensor providing an electric signal in the presence of low levels of arsenic. 'The arsenic water test works analogously to a diabetes test,' Sarphie explains. Enzyme electrochemistry creates a nanocurrent that is proportional to the analyte concentration. Aquaffirm has developed a proprietary modified enzyme, along with mediators that couple it to the electrode, Sarphie adds. The test was one of eight award winners at the Royal Society of Chemistry's Emerging Technologies Competition in 2018. Its cheap production cost makes the test viable for use in resource-limited countries. AquAffirm uses plastic with a thin layer of gold, patterned using laser ablation, to manufacture single-use,

Aquaffirm's cheap, disposable electro-chemistry test strips help communities steer clear of con-taminated wells

Gossip

disposable base electrodes. The user dips the test strip in a water sample and receives a measurement of arsenite within minutes. This rapid result is key, Sarphie says. About 10 million wells in Bangladesh require regular testing, as arsenic levels are variable and 20% of wells get replaced each year due to wear-and-tear. International organisations such as Unicef are planning a major arsenic-mitigation programme for Bangladesh, likely to start in 2020, in which AquAffirm hopes to participate. Confirming newly drilled wells are arsenic-free is also challenging, and workers would benefit from a speedy test to check that the well water is safe to drink, Sarphie says. AquAffirm also plans to introduce an electronic reader with a GPS tracker to the test which, along with software optimisation tools, would add an assessment of groundwater hot spots for arsenic contamination, according to Sarphie. The team will field test the technology in Mexico and Bangladesh this year. 'We've done a lot of work in the lab so we know that what we have is very sensitive and provides a linear readout of arsenic,' Sarphie says. 'The thing we want to look out for now is whether there are any other compounds in the water that could cause interference. We think we've addressed all the issues but we need to validate that in studies.' Sarphie sees the test ready for launch within a year, although the team is still raising money to finish off the product development. He will take it to Bangladesh first, where the problem is the most pressing. 'Unicef has said it is extremely excited about being able to use our product there because it will radically improve the way it manages the problem,' Sarphie says. Once the arsenic test has been established in the places where it is needed most, the team plans to take it to higher value markets too. 'The US has a pretty significant arsenic problem,' Sarphie explains. 'Some nine million Americans drink contaminated water on a regular basis.' Fracking activities in parts of Texas, Minnesota, California and Arizona are exacerbating the problem there, he adds. At the same time, AquAffirm wants to press on with a similar test for fluoride content in water. This works much the same way as the arsenic test, Sarphie explains. And a third product in the making will measure asparagine in flour. This is mainly aimed at industrial bakeries that need to comply with recent EU regulations on acrylamide content in baked goods. The carcinogen is formed from flour with a high asparagine content.

Chemistry World, 10 September 2019

https://www.chemistryworld.com</a

Gossip

New method for the measurement of nano-structured light fields

2019-09-24

Structured laser light has already opened up various different applications: it allows for precise material machining, trapping, manipulating or defined movement of small particles or cell compartments, as well as increasing the bandwidth for next-generation intelligent computing. If these light structures are tightly focused by a lens, like a magnifying glass used as burning glass, highly intense three-dimensional light landscapes will be shaped, facilitating a significantly enhanced resolution in named applications. These kinds of light landscapes have paved the way to pioneering applications as Nobel prize awarded STED microscopy. However, these nano-fields itself could not be measured yet, since components are formed by tight focusing which are invisible for typical measurement techniques. Up to now, this lack of appropriate metrological methods has impeded the breakthrough of nano-structured light landscapes as a tool for material machining, optical tweezers, or high-resolution imaging. A team around physicist Prof. Dr. Cornelia Denz of the Institute of Applied Physics and chemist Prof. Dr. Bart Jan Ravoo of the Centre for Soft Nanoscience at the University of Münster (Germany) successfully developed a nano-tomographic technique which is able to detect the typically invisible properties of nano-structured fields in the focus of a lens -- without requiring any complex analysis algorithms or data post-processing. For this purpose, the team combined their knowledge in the field of nano-optics and organic chemistry to realise an approach based on a monolayer of organic molecules. This monolayer is placed in the focused light field and replies to this illumination by fluorescence, embedding all information about the invisible properties. By the detection of this reply the distinct identification of the nano-field by a single, fast and straightforward camera image is enabled. "This approach finally opens the till now unexploited potential of these nano-structured light landscapes for many more applications," says Cornelia Denz, who is heading the study. The study has been published in the journal Nature Communications.

Physicists and chemists have jointly succeeded in developing a so-called nano-tomographic technique which is able to detect the typically invisible properties of nano-structured fields in the focus of a lens.

Science Daily, 20 September 2019

http://www.sciencedaily.com

Gossip

Corrosion resistance of steel bars in concrete when mixed with aerobic microorganisms

2019-09-24

Dissolved oxygen in pore solution is often a controlling factor determining the rate of the corrosion process of steel bars in concrete. This study reports on the corrosion resistance and polarisation properties of steel bars in a mortar specimen mixed with aerobic microorganisms. The addition of the microorganisms in mortar mixtures led to higher corrosion resistance, which was confirmed by the reduced rate of oxygen permeability, based on cathodic polarisation properties. This study reports on a novel method for enhancing corrosion resistance via reduced availability of dissolved oxygen in the cathodic reactions which could be obtained through metabolic processes of aerobic Bacillus subtilis natto in the presence of organic carbon sources. In addition, the approach is beneficial in facilitating the formation of calcium carbonate which seals cracks accompanied by the self-healing of concrete. Corrosion of steel bars in concrete leads to a decrease in the durability of reinforced concrete. The corrosion processes can be explained by electro-chemical reactions taking place in anodic and cathodic regions. The latter reaction requires oxygen and water, which is an electrolyte that can support the flow of electrons. Dissolved oxygen in pore solution is often a controlling factor determining the rate of the corrosion process of steel bars in concrete. The properties are essentially associated with the permeability of dissolved oxygen in the pore solution. This could be affected by the metabolic activities of aerobic Bacillus subtilis natto mixed in cementitious mixtures. Bacillus subtilis natto is resistant to unfavourable environmental conditions, including salinity and extreme pH, through the formation of an endospore at times of nutritional stress until conditions become favourable. Electro-chemical measurements were carried out to examine the corrosion processes by the AC impedance method, half-cell potential measurements, and macrocell corrosion measurements using zero-resistance ammeters. Cathodic polarization curves were measured at 28 and 91 days before and after the specimens were exposed to chloride induced corrosion tests through dry and wet cycles. The results indicate that the rate of oxygen permeability inferred based on limiting current density is substantially lower in the case of mortar specimens mixed with the Bacillus subtilis natto. This can be explained by the fact that the dissolved oxygen is consumed by the oxidation of organic matter, a process initially catalysed by Bacillus subtilis natto present in mortar mixtures during the monitoring periods. Based on the results obtained, the addition of a culture solution containing Bacillus subtilis natto reacting with dissolved oxygen resulted in higher

This study reports on the corrosion resistance and polarisation properties of steel bars in a mortar specimen mixed with aerobic microorganisms.

resistance against corrosion processes, which was confirmed by the results of half-cell potential and microcell and macrocell corrosion current density. There is a strong possibility that the reduced dissolved oxygen in the pore solution through the aerobic processes could enhance corrosion resistance in cracked mortar specimens.

Phys.org, 20 September 2019

http://phys.org

Keeping the crunch in low-fat chips

2019-09-24

University of Queensland chemical engineers have developed a new method to analyse the physical characteristics of potato chips in a bid to develop a tastier low-fat snack. Professor Jason Stokes said while a low-fat potato chip might reduce guilt, many people don't find the texture as appealing. "A key challenge in the food industry is reducing the amount of sodium, added sugar and saturated fat without sacrificing the taste, flavour, texture and mouthfeel in food and drink," Professor Stokes said. "Even subtle changes in the composition of processed food and drink can alter the consumer's acceptability of a product for reasons that are not well understood, which compromises healthy choices." Professor Stokes worked with flavour scientists including senior research fellow Dr. Heather Smyth, U.S. researcher Dr. Stefan Baier—now at Motif Ingredients—and former UQ postdoctoral researcher Dr. Michael Boehm who now works at PepsiCo, Inc. The team has been developing a more objective method of analysing the potato chips at four stages of simulated eating. "We wanted to simulate the entire eating process, from first bite, to the break down and softening of chip particles and finally swallowing the clumped mass of chip particles," he said. The researchers used the results to design a lower-fat chip coated in a thin layer of seasoning oil, which contained a small amount of a food emulsifier. In tests with sensory panellists, the seasoning oil made the low-fat chip more closely resemble the greasiness of a full-fat one, but it only added 0.5 percent more oil to the low-fat product. Professor Stokes said he had worked with all manner of food and drink. "Whether they be considered solids, powders, soft solids, semi-fluids or liquids, primarily the aim is to improve the efficiency of ingredients in oral processing and improve health benefits. "We also aim to consider the

University of Queensland chemical engineers have developed a new method to analyse the physical characteristics of potato chips in a bid to develop a tastier low-fat snack.

challenges in emerging areas that include the rise of consumer interest in plant-based foods and proteins."

Phys.org, 20 September 2019

http://phys.org

An eco-friendly method for the synthesis of cinnamaldehyde

2019-09-24

A RUDN University chemist has developed an ecologically safe method of obtaining cinnamaldehyde—a compound with antibacterial and anticancer activity. The scientist used catalysts based on iron and palladium nanoparticles to avoid the formation of environmentally harmful by-products. This eco-friendly approach can be extended to other organic compounds of the aldehyde class that are important for medicine, agriculture, and the food industry. The article is published in the journal Molecular Catalysis. Traditional methods of oxidation of alcohols to aldehydes and ketones using chromium and manganese lead to the formation of a large number of harmful by-products that must be separately disposed of. To avoid this, one can use soft selective oxidisers—for example, hydrogen peroxide. However, this reaction requires catalysis; without it, the yield of the product is not more than 10 percent. But existing catalysts, such as silver phosphate, platinum and palladium compounds, are also toxic or expensive. Therefore, the task of finding a cheap, efficient and eco-friendly catalyst for industrial production of cinnamaldehyde remains relevant. Chemists who create catalysts can solve several problems. Firstly, it is necessary to achieve high efficiency, that is, the catalyst should facilitate the reaction of the largest proportion of reagents incorporated in the initial mixture. Secondly, the catalyst must be highly selective—this means that the proportion of unwanted by-products must be minimal. Thirdly, the catalyst should be safe for the environment. All these problems are relevant for the oxidation reactions of alcohols, which result in the formation of aldehydes and ketones—important compounds for organic synthesis, medicine, perfume industry or agriculture. The research team led by RUDN University chemist Rafael Luque has proposed an effective and environmentally safe catalyst for the synthesis of cinnamaldehyde. This aromatic compound has antibacterial and anticarcinogenic activity and is widely used in the food and perfume industry as a flavouring agent, and in agriculture as a fungicide. One of the main ways to obtain it is the oxidation of cinnamyl alcohol. Luque has proposed to use catalysts based on iron and palladium nanoparticles

A RUDN University chemist has developed an ecologically safe method of obtaining cinnamaldehyde—a compound with antibacterial and anticancer activity.

obtained by the mechanochemical method. These nanoparticles catalyse the selective oxidation of cinnamyl alcohol by hydrogen peroxide under microwave irradiation. At the same time, they are environmentally safe and relatively cheap. However, in order for iron and palladium to work as catalysts, they must be applied to a suitable porous surface: its structure and chemical properties also determine the effectiveness of the entire catalytic system. As such matrices, chemists used several types of porous silicate and aluminosilicate substrates, which interact differently with oxygen and therefore lead to the formation of different products. To assess the effectiveness of the catalyst, chemists measured the degree of conversion, that is, the proportion of alcohol converted to aldehyde. To test the selectivity of catalysts, scientists measured the ratio of cinnamaldehyde to an unwanted by-product—benzaldehyde—in the final mixture. The most effective catalyst was a system of iron nanoparticles on an aluminosilicate zeolite matrix. The conversion rate for it was above 80 percent—higher than that of palladium catalysts and the solution of iron salts. In this case, the catalyst of palladium nanoparticles on a magnetic silicate substrate surpassed the selectivity of all other options. After using this catalyst, the proportion of cinnamaldehyde in the final mixture exceeded 60 percent. To understand why iron-based catalysts are more effective and palladium-based catalysts are more selective, the authors studied the underlying mechanism. They found that the oxidation of cinnamyl alcohol formed an intermediate product with an epoxy group, because of it, more efficient catalysts accelerate simultaneously the oxidation reaction with the destruction of the carbon chain and the formation of shorter molecules of benzaldehyde, which reduces the selectivity. Despite the fact that the high efficiency of the studied catalytic systems is associated with a decrease in selectivity, catalysts consist of iron nanoparticles on zeolite matrices have both indicators high enough for potential use in industrial production. The authors think that due to high activity of such catalysts—primarily based on iron nanoparticles—it can be used to oxidise not only cinnamyl alcohol but also other compounds with a similar chemical structure.

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http://phys.org

Gossip

The best of two worlds: Magnetism and Weyl semimetals

2019-09-24

Imagine a world in which electricity could flow through the grid without any losses or where all the data in the world could be stored in the cloud without the need for power stations. This seems unimaginable but a path towards such a dream has opened with the discovery of a new family of materials with magical properties. These materials - magnetic Weyl semi-metals - are innately quantum but bridge the two worlds of topology and spintronics. Topological materials exhibit strange properties including super-fast electrons that travel without any energy loss. On the other hand, magnetic materials are essential to our everyday lives from magnets for electric cars to spintronic-devices in every hard disk drive in computers and in the cloud. The concept of a magnetic Weyl semi-metal (WSM) was in the air but a real-life material has only just now been realised by the team of Claudia Felser, Director at the MPI CPfS, Dresden, in two very different compounds Co2MnGa and Co3Sn2S2. To find these extraordinary materials, Felser's team scanned the materials database and came up with a list of promising candidates [1-5]. The proof that these materials are magnetic WSMs was obtained via electronic structure investigations of Co2MnGa and Co3Sn2S2 [6-8]. Scientists from Claudia Felser's group at the MPI CPfS and Stuart Parkin's team at the MPI of Microstructure Physics, Halle, in collaboration with M. Zahid Hasan's team from Princeton, Yulin Chen's team from Oxford University, and Haim Beidenkopf's team from the Weizmann Institute of Science, have experimentally confirmed the existence of magnetic Weyl fermions in these two materials in studies that were published in three papers in Science Magazine. For the very first time, using angle-resolved photoemission spectroscopy (ARPES) and scanning tunnelling microscope (STM) experiments, time-reversal symmetry broken WSM states were observed, made possible by the high-quality single crystals grown at the MPI CPfS. "The discovery of magnetic WSMs is a big step towards the realisation of high temperature quantum and spintronic effects. These two materials, that are members of the highly tunable Heusler and Shandite families, respectively, are ideal platforms for various future applications in spintronic and magneto-optic technologies for data storage, and information processing as well as applications in energy conversion systems," says Stuart Parkin, the Managing Director of the Max Planck Institute of Microstructure Physics, Halle. The magnetic topological states in Co2MnGa and Co3Sn2S2 play a crucial role in the origin of the observed anomalous quantum transport effects, due to the strong Berry curvature associated with their topological states. With Weyl

nodal line and nodal point band structures, Co2MnGa and Co3Sn2S2 are the only two currently known examples of materials that host both large anomalous Hall conductivity and anomalous Hall angle [3, 4, 6]. "Our materials have the natural advantages of high order temperature, clear topological band structure, low charge carrier density, and strong electromagnetic response. The design of a material that exhibits a high temperature quantum anomalous Hall effect (QAHE) via quantum confinement of a magnetic WSM, and its integration into quantum devices is our next step," says Claudia Felser. The discovery of magnetic WSMs is a big step to the realisation of a room temperature QAHE and is the basis for new energy conversion concepts "A Quantum Anomalous Hall effect enables dissipationless transport via chiral edge states that are innately spin-polarised." realised Yan Sun immediately. Realisation of the QAHE at room temperature would be revolutionary by overcoming limitations of many of today's data-based technologies, which are affected by large electron scattering-induced power loss. This would pave the way to a new generation of low energy consuming quantum electronic and spintronic devices.

EurekAlert, 20 September 2019

http://www.eurekalert.org

A bathroom scale could monitor millions with heart failure

2019-09-24

In a new study, researchers reported proof-of-concept success in recording and processing data from 43 patients with heart failure.

"Good morning. Bill. Please. Step onto the scale. Touch the metal pads." The device records an electrocardiogram from Bill's fingers and - more importantly - circulation pulsing that makes his body subtly bob up and down. Machine learning tools compute that Bill's heart failure symptoms have worsened. This is how researchers at the Georgia Institute of Technology envision their experimental device reaching patients someday, and in a new study, they reported proof-of-concept success in recording and processing data from 43 patients with heart failure. A future marketable version of the medical monitoring scale would ideally notify a doctor, who would call Bill to adjust his medication at home, hopefully sparing him a long hospital stay and needless suffering. The pulsing and bobbing signal is called a ballistocardiogram (BCG), a measurement researchers took more commonly about 100 years ago but gave up on as imaging technology far surpassed it. The researchers are making it useful again with modern computation. "Our work is the first time that BCGs have been used to classify the status of heart failure patients," said Omer Inan,

the study's principal investigator and an associate professor in Georgia Tech's School of Electrical and Computer Engineering.

Healthcare crisis

Heart failure affects 6.5 million Americans and is a slow-progressing disease, in which the heart works less and less effectively. Many people know it as congestive heart failure because a major symptom is fluid build-up, which can overwhelm the lungs, impeding breathing and possibly causing death. Patients endure repeat hospitalisations to adjust medications when their condition dips, or "decompensates," making heart failure a major driver of hospital admissions and healthcare costs. Home monitoring reduces hospitalisations but currently requires an invasive procedure. Georgia Tech research was behind the launch of such an implantable heart failure home monitoring device in 2011. But this new solution would potentially dispense with the procedure, cost much less, and be much simpler to use - lowering patients' resistance to home monitoring. Given its early stage, the study's BCG-EKG scale performed well in hospital tests but also in in-home tests, which was promising, since the solution principally targets eventual home use. The research team, which included collaborators from the University of California, San Francisco, and Northwestern University, published their results in the journal IEEE Transactions on Biomedical Engineering. The research was funded by the National Heart, Lung and Blood Institute at the National Institutes of Health.

Ballisto scribble

The EKG part of the experimental scale is not new nor its great diagnostic information, but it alone does not say enough about heart failure. The BCG part is mostly new, and it appears valuable to heart failure monitoring but also challenging to record and interpret. "The ECG (EKG) has characteristic waves that clinicians have understood for 100 years, and now, computers read it a lot of the time," Inan said. "Elements of the BCG signal aren't really known well yet, and they haven't been measured in patients with heart failure very much at all." The EKG is electrical; the body conducts its signals well, and the recordings are clear. The BCG is a mechanical signal; body fat dampens it, and it faces a lot of interference in the body like tissue variations and muscle movement. BCGs are also noisier in people with cardiovascular disease. Patients with heart failure tend to be feebler, and initially, the researchers worried they would wobble on scales during home tests, adding even more noise to the BCGs. But the recordings were very productive. Though a BCG read-out is scribble compared to an EKG's

near-uniform etchings, BCGs have some patterns that parallel an EKG's. For example, the big upward spike in an EKG is followed by the BCG's big "J-wave."

Inconsistent throbbing

The researchers processed BCGs with three machine learning algorithms, revealing patterns that differ when a patient's heart failure is compensated, that is, healthier, from when it is decompensated. "In someone with decompensated heart failure, the cardiovascular system can no longer compensate for the reduced heart function, and then the flow of blood through the arteries is more disorderly, and we see it in the mechanical signal of the BCG," Inan said. "That difference does not show up in the ECG because it's an electrical signal." "The most important characteristic was the degree to which the BCG is variable, which would mean inconsistent blood flow. If you chop up the recording into 20-second intervals and the individual segments differ from each other a lot, that's a good marker of decompensation," Inan said.

EurekAlert, 19 September 2019

http://www.eurekalert.org

'Nanochains' could increase battery capacity, cut charging time

2019-09-24

A new method could allow better materials to make up battery electrodes by converting them into a nanochain structure, extending battery lifetime and increasing stability.

How long the battery of your phone or computer lasts depends on how many lithium ions can be stored in the battery's negative electrode material. If the battery runs out of these ions, it can't generate an electrical current to run a device and ultimately fails. Materials with a higher lithium ion storage capacity are either too heavy or the wrong shape to replace graphite, the electrode material currently used in today's batteries. Purdue University scientists and engineers have introduced a potential way that these materials could be restructured into a new electrode design that would allow them to increase a battery's lifespan, make it more stable and shorten its charging time. The study, appearing as the cover of the September issue of Applied Nano Materials, created a net-like structure, called a "nanochain," of antimony, a metalloid known to enhance lithium ion charge capacity in batteries. The researchers compared the nanochain electrodes to graphite electrodes, finding that when coin cell batteries with the nanochain electrode were only charged for 30 minutes, they achieved double the lithium-ion capacity for 100 charge-discharge cycles.

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Some types of commercial batteries already use carbon-metal composites similar to antimony metal negative electrodes, but the material tends to expand up to three times as it takes in lithium ions, causing it to become a safety hazard as the battery charges. "You want to accommodate that type of expansion in your smartphone batteries. That way you're not carrying around something unsafe," said Vilas Pol, a Purdue associate professor of chemical engineering. Through applying chemical compounds -- a reducing agent and a nucleating agent -- Purdue scientists connected the tiny antimony particles into a nanochain shape that would accommodate the required expansion. The particular reducing agent the team used, ammonia-borane, is responsible for creating the empty spaces -- the pores inside the nanochain -- that accommodate expansion and suppress electrode failure. The team applied ammonia-borane to several different compounds of antimony, finding that only antimony-chloride produced the nanochain structure. "Our procedure to make the nanoparticles consistently provides the chain structures," said P. V. Ramachandran, a professor of organic chemistry at Purdue. The nanochain also keeps lithium ion capacity stable for at least 100 charging-discharging cycles. "There's essentially no change from cycle 1 to cycle 100, so we have no reason to think that cycle 102 won't be the same," Pol said. Henry Hamann, a chemistry graduate student at Purdue, synthesized the antimony nanochain structure and Jassiel Rodriguez, a Purdue chemical engineering postdoctoral candidate, tested the electrochemical battery performance. The electrode design has the potential to be scalable for larger batteries, the researchers say. The team plans to test the design in pouch cell batteries next.

EurekAlert, 19 September 2019

http://www.eurekalert.org

Combining empirical knowledge and machine learning with a small experimental dataset

Best performance of organic material for lithium battery anode using materials informatics

2019-09-24

At JST Strategic Basic Research Programs, the research group led by associate professor Yuya Oaki and graduate student (at the time) Hiromichi Numazawa of Faculty of Science and Technology, Keio University established a new design policy for organic materials for the anode of lithium-ion secondary cells in a joint work with research associate Yasuhiko Igarashi of Graduate School of Frontier Sciences, The University of Tokyo, through the use of Materials Informatics (MI)1). A high-capacity and high-stability material was successfully obtained via an extremely

Gossip

small number of experiments. In order to conserve resources for batteries, organic materials without the use of metal is being researched worldwide. Traditionally, search for anode materials for lithium batteries and sodium-ion batteries had to rely on trial and error or experience and intuition of researchers. MI generally performs machine learning for a large-scale data (big data), and is a technique that reduces involvement of researchers' experience and intuition. One of the challenges was how experimental researchers use their own small-scale data and empirical knowledge. The research group examined a method, "experiment-oriented MI", which fuses small-scale but relatively accurate experimental data with experience and intuition of experimental researchers, and has achieved improved yield of nanosheet materials and so on. In this study, the capacity of 16 organic compounds as an anode was measured; further, a small number of factors that can determine the capacity using sparse modelingn2), which is a data science technique, was identified. Based on this result, a capacity prediction formula was developed by considering the identified factors as variables (prediction model). Next, 11 commercially available compounds, with expectation for a certain capacity as an anode, were selected partially based on the experience and intuition of researchers, and the predicted capacity value was calculated prior to the experiment. Further, the capacity of three compounds with the highest predicted value was measured, and two compounds were observed to exhibit high capacity. Subsequently, one of these compounds, the thiophene compound, was polymerized and a polymer anode material with improved capacity, durability, and quick charge-discharge property was obtained. The design policy for the organic anode material established in the present study is important for further improvement in performance. Combining a small experimental dataset, experience and intuition of researchers, and machine learning led to a successful discovery of a high-performance material. It also showed the effectiveness of combining experimental science and MI in improving the efficiency of material search.

EurekAlert, 20 September 2019

http://www.eurekalert.org

Programmable swarmbots help make flexible biological tools

2019-09-24

Biomedical engineers at Duke University have developed a new platform to create biologic drugs using specially engineered bacteria that burst and release useful proteins when they sense that their capsule is becoming too

Biomedical engineers at Duke University have developed a new platform to create biologic drugs using specially engineered bacteria that burst and release useful proteins when they sense that their capsule is becoming too crowded.

crowded. The platform relies on two main components: the engineered bacteria, called "swarmbots," that are programmed to sense the density of their peers within their container, and the biomaterial that confines the swarmbots, a porous capsule that can shrink in response to changes in the bacterial population. When it shrinks, the capsule squeezes out targeted proteins created by the captive bacteria. This self-contained platform could make it easier for researchers to create, analyse and purify diverse biologics for use in small-scale biomanufacturing. The research appeared online Sept. 16 in the journal Nature Chemical Biology. Bacteria are commonly used to produce biologics, which are products like vaccines, gene therapies and proteins that are created or synthesised from biological sources. Currently, this process involves a series of sophisticated steps including cell culturing, protein isolation and protein purification, each of which requires delicate infrastructure to ensure efficiency and quality. For industrial operations, these steps are carried out on a large scale. While this helps produce large quantities of certain molecules, this setup is not flexible or financially viable when researchers need to produce small amounts of diverse biologics or work in resource-limited settings. The new technology was developed by Lingchong You, a Professor of Biomedical Engineering at Duke University, and a former Duke postdoctoral researcher, Zhuojun Dai, now an Associate Professor at Shenzhen Institute of Advanced Technologies. In the new study, they show how their new platform uses communication between swarmbots and their capsule to achieve versatile production, analysis and purification of diverse proteins and protein complexes. In an earlier proof of concept, You and his team engineered a non-pathogenic strain of E. coli bacteria to produce an antidote to antibiotics when the bacteria reached a certain density. These swarmbots were then confined to a capsule, which was bathed in antibiotics. If a bacterium left the capsule it was destroyed, but if it remained inside the container where the population density was high, it survived. "Our first study essentially showed one-way communication, where the cells could sense the environment within the capsule but the environment didn't react to the cells," said You. "Now, we have two-way communication—the engineered swarmbots can still sense their density and their confinement, but we have introduced a material that can respond when the bacterial population inside it changes. It's like the two components are talking to each other, and collectively they give you very dynamic behaviour." Capsules containing tailored bacteria called "swarmbots" grow and shrink in response to the chemical environment they contain. The swarmbots sense their own population density has reached a certain level and split open to release their contents, including a protein they've been engineered to manufacture. Once the population

inside the capsule reaches a certain density, the bacteria start to 'pop,' releasing all of their cellular contents, including the protein product of interest. At the same time, this bacterial growth changes the chemical environment within the capsule, causing it to shrink. As it shrinks, it squeezes out the protein released from the bursting cells while the bacteria and cell debris are kept within the capsule. Once the proteins are collected, researchers can add a nutrient replenishment to the dish as a cue for the capsules to enlarge. This resets the interior environment and allows the bacteria to begin growing again, restarting the process. According to You, this cycle can be repeated for up to a week. To make the approach useful for biomanufacturing, the team added the capsules to a microfluidic chip, which included a chamber for them to detect and quantify which proteins were released. This could be replaced with a purification chamber to prepare the proteins for use in biologics. "It's a very compact process. You don't need electricity, and you don't need a centrifuge to produce and isolate these proteins," said You. "It makes this a good platform for biomanufacturing. You have the ability to produce a certain type of medicine in a very compact format at a low cost, and it's easy to deliver. On top of that, this platform offers an easy way to produce multiple proteins simultaneously." According to You, this ease of use has enabled the team to produce, quantify and purify more than 50 different proteins in collaboration with the lab of Ashutoshi Chilkoti, Alan L. Kaganov Professor and Chair of the Department of Biomedical Engineering at Duke. They have also explored how their platform can simplify the creation of protein complexes, which are structures made from multiple proteins. On a proof-of-concept experiment to produce a fatty acid synthesis pathway from multiple enzymes, "we were able to use seven versions of our microbial swarmbots, each of which was programmed to produce a different enzyme," said You. "Usually, to produce a metabolic pathway you'd need to balance the supply chain, which could involve upregulating the expression of one enzyme and downregulating the expression of another. With our platform you don't need to do that, you just need to set the correct ratio of swarmbots." "This technology is incredibly versatile," he said. "That's a capability we want to take advantage of."

Phys.org, 17 September 2019

http://phys.org

Researchers at the University of Warwick have isolated elusive transition metal compounds of N2O that provide clues into how it could be used in sustainable chemical technologies.

Gossip

Elusive compounds of greenhouse gas isolated

2019-09-24

Nitrous oxide (N2O) is a potent atmospheric pollutant. Although naturally occurring, anthropogenic N2O emissions from intensive agricultural fertilisation, industrial processes, and combustion of fossil fuels and biomass are a major cause for concern. Researchers at the University of Warwick have isolated elusive transition metal compounds of N2O that provide clues into how it could be used in sustainable chemical technologies. N2O is a powerful greenhouse gas, with a half-life of 114 years in the atmosphere and global warming potential 300 times greater than carbon dioxide. It is also the dominant ozone depleting substance emitted in the 21st century. As an abundant chemical feedstock, the use of N2O as a sustainable oxidant in synthetic organic chemistry is an attractive prospect, liberating environmentally benign dinitrogen (N2). Such reactions are encumbered by the robust triatomic formulation of this gas, typically requiring forcing reaction conditions that are energy intensive and undesirable from a remediation perspective. The development of mild and selective alternatives is a longstanding ambition of research scientists, but has been met with little success. In their paper 'Rhodium(I) Pincer Complexes of Nitrous Oxide' published in the journal Angewandte Chemie, researchers from the University of Warwick's Department of Chemistry have reported well-defined compounds of nitrous oxide that provide valuable insights into how this gas interacts with one of the most widely employed transition metals in organic synthesis. The associated experimental data is the most comprehensive collected to date for any transition metal adduct, for which there are very few precedents. This work provides a fundamental reference point in the field and is likely to stimulate and guide future catalyst developments. Dr. Adrian Chaplin from the Department of Chemistry at the University of Warwick comments: "Nitrous oxide is commonly known as laughing gas, but it's environmental impact is certainly nothing to laugh about and often overlooked altogether. As a chemical reagent its potential has yet to be fully harnessed, and to do so a sustainable manner is formidable challenge for the scientific community." "In my team, we are trying to tackle this problem using a fundamental, bottom up, approach. The compounds that we have prepared represent the starting point of our journey, but the associated experimental data seems to be guiding us in the right direction and we are looking forward to where it takes us."

Phys.org, 17 September 2019

http://phys.org

Gossip

Let there be light: Synthesizing organic compounds

2019-09-24

Every biological reaction is a chemical reaction. The exchange of carbon dioxide for oxygen in our lungs and blood cells, for example, is caused by molecules releasing chemicals and reforming with new ones. The uncontrolled replication of cancerous cells is the result of broken chemical compounds miscommunicating. The appeal of developing improved drugs to promote helpful reactions or prevent harmful ones has driven organic chemists to better understand how to synthetically create these molecules and reactions in the laboratory. A team from Yokohama National University in Japan has taken a step toward making this wish a reality with their latest study, published on July 19 in the Journal of Organic Chemistry. The researchers developed oxygen heterocycles, which are ring structures consisting of atoms from two or more elements. These compounds make up all of the nucleic acids in a person's genetic code. Another version of heterocycles, containing nitrogen, are in more than half of the pharmaceuticals produced in the United States. Oxygen heterocycles in particular contain at least one oxygen atom. They have a variety of uses, including in medications to treat cancer and heart failure. "We focused on oxygen heterocycles, which have attracted significant interest due to the relevance of their structural units in medicinal chemistry and materials science," said Yujiro Hoshino, the study's corresponding author and a research fellow in the Graduate School of Environment and Information Sciences at Yokohama National University. Professor Kiyoshi Honda, another corresponding author of the study from the Graduate School of Environment and Information Sciences added that their "goal was to develop cost-effective and milder synthetic routes to create oxygen heterocycles." Traditionally, oxygen heterocycles are made by applying high temperatures to two molecules. The process consumes time and energy, and doesn't produce a significant number of heterocycles. Honda and Hoshino's team focused on a method involving the design of photo-sensitive carbon-based salts. They added the salts to two types of compounds, which form a ring once they react, and irradiated the combination with green light. "This reaction was particularly attractive because it can hold a high number of atoms and provides efficient access to various synthetically useful oxygen-containing heterocycles," Hoshino said. "This reaction can also be carried out in mild experimental conditions -- room temperature and visible light." The process produced a high yield of oxygen heterocycles. According to Hoshino, the successful reaction was due to a structure on the salts called an electron-donating group. Electrons are excited by green light, and the salts extract an electron

from the compound to react with the other compound components. Next, the researchers plan to turn to different coloured light to drive different reactions. They're specifically interested in establishing a red-light reaction, which is more difficult, according to Hoshino. Red light is a longer wavelength and lower frequency than green light, meaning it's closer infrared light than visible light on the spectrum chart. Red-light reactions could drive a higher production of heterocycles, but it requires more accuracy and efficiency. "Our next goal is to expand the scope of reaction," Hoshino said. "We envision the expansion of the use of various visible-light-driven reactions in the future, and we plan to continue contributing to it."

Science Daily, 19 September 2019

http://www.sciencedaily.com

Microbe chews through PFAS and other tough contaminants

2019-09-24

In a series of lab tests, a relatively common soil bacterium has demonstrated its ability to break down the difficult-to-remove class of pollutants called PFAS, researchers said.

In a series of lab tests, a relatively common soil bacterium has demonstrated its ability to break down the difficult-to-remove class of pollutants called PFAS, researchers at Princeton University said.
The bacterium, Acidimicrobium bacterium A6, removed 60% of PFAS _specifically perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS) _ in lab vials over 100 days of observation, the researchers reported in a Sept. 18 article in the journal Environmental Science and Technology.
Because of their health concerns and ubiquity, EPA has recently opened a research effort into the chemicals impact in drinking water. Peter Jaffe, the lead researcher and a professor of civil and environmental engineering at Princeton, said the researchers were very encouraged to see these bacteria substantially degrade the famously recalcitrant class of chemicals but cautioned that more work was needed before reaching a workable treatment. "This is a proof of concept," said Jaffe, the William L. Knapp '47 Professor of Civil Engineering. "We would like to get the removal higher, and then go and test it in the field." PFAS (Per- and polyfluoroalkyl substances) have been widely used in products from non-stick pans to firefighting foam, and the Environmental Protection Agency has said there is evidence that exposure to PFAS is harmful to human health. Because of this, U.S. manufacturers have phased out several versions of PFAS in their products. But the substance is long-lived and extremely difficult to remove from soil and ground water. In recent years, local governments have been seeking ways to reduce the amount of PFAS in water supplies.

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Because of the strength of the carbon-fluorine bond, these chemicals are extremely difficult to remove through conventional means. But Jaffe and co-researcher, Shan Huang, an associate research scholar at Princeton, suspected that the Acidimicrobium A6 might be an effective remedy. The researchers first began working with the bacteria several years ago when they investigated a phenomenon in which ammonium broke down in acidic, iron-rich soils in New Jersey wetlands and similar locations. Because removing ammonium is a critical part of sewage treatment, the researchers wanted to understand what was behind the process, called Feammox. In their initial research in 2013, Jaffe and fellow researchers removed soil samples from the Assunpink wetland outside Trenton. They cultivated the samples in the lab with an eye to identify the microorganisms responsible for the Feammox process. The researchers learned that the Feammox reaction occurred in the presence of Acidimicrobium A6, but it required several years of painstaking work to isolate this organism and grow it as a pure culture. One challenge in working with Acidimicrobium A6 is the bacterium's demand for iron both to grow and eliminate compounds like ammonium. Jaffe, along with graduate students Weitao Shuai and Melany Ruiz, now a post-doctoral researcher at Rutgers, determined that they could substitute an electrical anode for the iron in lab reactors. This allowed the researchers to more easily grow these bacteria and work with them; it also presented a possible way to develop reactors for remediation in the absence of iron. When they sequenced the Acidimicrobium A6 genome, the researchers noticed certain characteristics that opened the possibility that the bacterium could be effective in removing PFAS. "We knew this was a big environmental challenge, to find an organism that could degrade these perfluorinated organics," Jaffe said. To test their hypothesis, the researchers sealed samples of Acidimicrobium A6 in lab containers and then tested the bacteria's ability to break down the compounds in lab reactors. After 100 days, the researchers stopped the test and determined that the bacteria had removed 60 percent of the contaminants and released an equivalent amount of fluoride in the process. Jaffe said the 100-day period was an arbitrary length selected for the experiment, and that longer incubations might result in more PFAS removal. The researchers also plan to vary conditions in the reactor to find the optimum conditions for PFAS removal. Acidimicrobium A6 thrives in low oxygen conditions, which makes it particularly effective for soil and groundwater remediation and allows it to function without expensive aeration. However, these bacteria also require iron and acidic soil conditions. Jaffe said this could limit their deployment, but adjusting soil conditions could also allow the bacteria to function in areas that do not naturally meet these requirements.

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Noting previous work on ammonium reduction by Acidimicrobium A6 in soil columns, constructed wetlands, and the electrochemical reactors, Jaffe said the researchers believe this could also be done for PFAS remediation. Jaffe said the researchers are also working with Mohammad R. Seyedsayamdost, an associate professor of chemistry, and colleagues in the chemistry department to better understand the enzymes involved in the defluorination process. Characterising those enzymes could provide insights that increase effectiveness in remediation. Support for the research was provided in part by the Helen Shipley Hunt Fund.

Science Daily, 18 September 2019

http://www.sciencedaily.com

Scientists' design discovery doubles conductivity of indium oxide transparent coatings

2019-09-24

Researchers at the University of Liverpool, University College London (UCL), NSG Group (Pilkington) and Diamond Light Source have made an important design discovery that could dramatically improve the performance of a key material used to coat touch screens and other devices. Tin doped indium oxide -ITO—is the leading material used in the coating applied to the glass or clear plastic of touch screens, solar cells and light emitting diodes because it conducts electricity and allows light through. ITO accounts for 60 per cent of the multibillion-dollar transparent conducting oxide market and 60 per cent of global indium use. However, the search for materials that can replace ITO has increased significantly in recent years, as supplies of indium decrease and its price significantly increases. Now, researchers have made an important design discovery that could see films and coatings which don't rely so heavily on this rare element. In a paper published in Materials Horizons, scientists used a combination of experimental and theoretical approaches to explain how replacing tin with the transition metal molybdenum creates a vastly superior material—IMO—that has twice the conductivity of ITO. It can deliver better performance than ITO with only half the thickness and half the amount of indium. Ph.D. student Jack Swallow, from the University of Liverpool's Department of Physics and the Stephenson Institute for Renewable Energy, said: "This is an exciting new development in the field of transparent conductors and has the potential of extending the life of the world's indium supplies, which are in increasingly short supply." Professor David Scanlon of UCL said: "Our work illustrates the power of combining chemistry and physics experimental approaches with

Superior transparent conducting properties of indium oxide realised by molybdenum donors resonant in the conduction band, avoiding detrimental effects of tin doping.

computational materials design." The researchers now intend to apply their new understanding to find alternative novel dopants to improve other transparent conductors. This includes tin dioxide which contains only earth abundant elements and so is cheap enough for large area uses such as solar cells and energy efficient windows. Liverpool Professor, Tim Veal, a co-author on the paper said: "Although IMO was first made several years ago, the reason why it is so much better than ITO wasn't understood. "Our research finding represents a breakthrough and opens the way for industry to reduce its use of indium in displays and touch screens and provides a route for commercial development of better, cheaper transparent conductors for renewable energy applications."

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http://phys.org

New approach suggests path to emissions-free cement

2019-09-24

A team of researchers at MIT has come up with a new way of manufacturing cement that could eliminate emissions altogether, and could even make some other useful products in the process.

It's well known that the production of cement—the world's leading construction material—is a major source of greenhouse gas emissions, accounting for about 8 percent of all such releases. If cement production were a country, it would be the world's third-largest emitter. A team of researchers at MIT has come up with a new way of manufacturing the material that could eliminate these emissions altogether, and could even make some other useful products in the process. The findings are being reported today in the journal PNAS in a paper by Yet-Ming Chiang, the Kyocera Professor of Materials Science and Engineering at MIT, with postdoc Leah Ellis, graduate student Andres Badel, and others. "About 1 kilogram of carbon dioxide is released for every kilogram of cement made today," Chiang says. That adds up to 3 to 4 gigatons (billions of tons) of cement, and of carbon dioxide emissions, produced annually today, and that amount is projected to grow. The number of buildings worldwide is expected to double by 2060, which is equivalent to "building one new New York City every 30 days," he says. And the commodity is now very cheap to produce: It costs only about 13 cents per kilogram, which he says makes it cheaper than bottled water. So, it's a real challenge to find ways of reducing the material's carbon emissions without making it too expensive. Chiang and his team have spent the last year searching for alternative approaches, and hit on the idea of using an electrochemical process to replace the current fossil-fuel-dependent system. Ordinary Portland cement, the most widely used standard variety, is made by grinding up limestone and then cooking it with sand and clay at high

heat, which is produced by burning coal. The process produces carbon dioxide in two different ways: from the burning of the coal, and from gases released from the limestone during the heating. Each of these produces roughly equal contributions to the total emissions. The new process would eliminate or drastically reduce both sources, Chiang says. Though they have demonstrated the basic electrochemical process in the lab, the process will require more work to scale up to industrial scale. First of all, the new approach could eliminate the use of fossil fuels for the heating process, substituting electricity generated from clean, renewable sources. "In many geographies renewable electricity is the lowest-cost electricity we have today, and its cost is still dropping," Chiang says. In addition, the new process produces the same cement product. The team realised that trying to gain acceptance for a new type of cement—something that many research groups have pursued in different ways—would be an uphill battle, considering how widely used the material is around the world and how reluctant builders can be to try new, relatively untested materials. The new process centres on the use of an electrolyzer, something that many people have encountered as part of high school chemistry classes, where a battery is hooked up to two electrodes in a glass of water, producing bubbles of oxygen from one electrode and bubbles of hydrogen from the other as the electricity splits the water molecules into their constituent atoms. Importantly, the electrolyzer's oxygen-evolving electrode produces acid, while the hydrogen-evolving electrode produces a base. In the new process, the pulverised limestone is dissolved in the acid at one electrode and high-purity carbon dioxide is released, while calcium hydroxide, generally known as lime, precipitates out as a solid at the other. The calcium hydroxide can then be processed in another step to produce the cement, which is mostly calcium silicate. The carbon dioxide, in the form of a pure, concentrated stream, can then be easily sequestered, harnessed to produce value-added products such as a liquid fuel to replace gasoline, or used for applications such as oil recovery or even in carbonated beverages and dry ice. The result is that no carbon dioxide is released to the environment from the entire process, Chiang says. By contrast, the carbon dioxide emitted from conventional cement plants is highly contaminated with nitrogen oxides, sulfur oxides, carbon monoxide and other material that make it impractical to "scrub" to make the carbon dioxide usable. Calculations show that the hydrogen and oxygen also emitted in the process could be recombined, for example in a fuel cell, or burned to produce enough energy to fuel the whole rest of the process, Ellis says, producing nothing but water vapor. In their laboratory demonstration, the team carried out the key electrochemical steps required, producing lime from the calcium carbonate, but on a small scale. The process looks a

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bit like shaking a snow-globe, as it produces a flurry of suspended white particles inside the glass container as the lime precipitates out of the solution. While the technology is simple and could, in principle, be easily scaled up, a typical cement plant today produces about 700,000 tons of the material per year. "How do you penetrate an industry like that and get a foot in the door?" asks Ellis, the paper's lead author. One approach, she says, is to try to replace just one part of the process at a time, rather than the whole system at once, and "in a stepwise fashion" gradually add other parts. The initial proposed system the team came up with is "not because we necessarily think we have the exact strategy" for the best possible approach, Chiang says, "but to get people in the electrochemical sector to start thinking more about this," and come up with new ideas. "It's an important first step, but not yet a fully developed solution."

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http://phys.org

Curiosities

Plastic Alternatives Could Make Marine Pollution Even Worse, Report Finds

2019-09-25

Compostable alternatives to plastic could worsen marine pollution and have other serious environmental impacts, a report from a committee of UK MPs has warned. The world has a plastic problem -- millions of tons of plastic enter the oceans every year, polluting our seas, littering our beaches and endangering wildlife. In an attempt to curb the devastation wreaked on the oceans and on the environment, many businesses and consumers are turning to alternatives to plastic -- like biodegradable or compostable packaging. But instead of alleviating the problem of pollution, replacing plastic with other materials can still have a disastrous environmental impact, a report released by the UK Parliament's Environment, Food and Rural Affairs Committee warned. In fact, such alternatives could even increase pollution by making people complacent about their use and disposal, the report released recently suggested. It cited the environmental group Green Alliance, which had raised concerns about evidence that 'people are more likely to discard material described as 'biodegradable' in the environment, which would make pollution on land and at sea even worse.' The report found that consumers were confused about how to dispose of compostable packaging, which could result in contamination of recycling, as well as littering. The committee said that materials were being used as substitutes for plastic 'without proper consideration of wider environmental consequences, such as higher carbon emissions.' In evidence included in the report, Juliet Phillips, ocean campaigner at the Environmental Investigation Agency stated that 'if a biodegradable cup gets into the sea, it could pose just as much of a problem to marine life as a conventional plastic cup.' The committee recommended that the UK Government should conduct a review of reusable and refillable packaging systems, and said that the UK government was not putting enough emphasis on reducing plastic food and drink packaging in the first place. 'We all know that plastic pollution of our rivers and seas is a huge problem. However, replacing plastic with other materials isn't always the best solution, as all materials have an environmental impact,' said MP Neil Parish, the committee chair. 'My committee is also concerned that compostable plastics have been introduced without the right infrastructure or consumer understanding about how to dispose of them. Fundamentally, substitution is not the answer, and we need to look at ways to cut down on single use packaging,'

Compostable alternatives to plastic could worsen marine pollution and have other serious environmental impacts, a report from a committee of UK MPs has warned.

he added. 'All food and drink packaging, whether plastic or another material, has an environmental impact,' the committee found.

Kezi, 12 September 2019

https://www.kezi.com

First peanut allergy treatment gains backing from FDA advisory panel

2019-09-25

After 8 hours of contentious discussion, an advisory committee to the United States Food and Drug Administration (FDA) endorsed the effectiveness of a first-of-its-kind peanut allergy treatment. By a seven-to-two vote, the panel concluded that the treatment, known as AR101, can reduce allergic reactions from accidental exposure to peanuts. The committee also voted eight to one to endorse a safety plan FDA has proposed; it would be used, along with available safety data, to support the treatment's use in children and teenagers. FDA is not bound to follow its advisory committees' advice but often does. It will now weigh whether to approve the treatment, which is marketed by the company Aimmune Therapeutics headquartered in Brisbane, California. The vote marks a turning point for the food allergy field, where the treatment—ingesting gradually increasing doses of peanut protein, in hopes of helping the immune system learn to tolerate it—has captured the attention of patients, families, and doctors. Called oral immunotherapy, it's already offered by about 200 allergists in the United States who give patients calibrated doses of peanut products in the doctor's office and at home. But hundreds more doctors have been waiting for FDA's approval of Aimmune's version, a designated capsule that contains powder derived from peanut flour and holds peanut proteins at consistent levels. Aimmune formed in 2011; it received $3.5 million in early support from Food Allergy Research & Education (FARE), an advocacy group headquartered in McLean, Virginia, whose members desperately wanted something more than what physicians had to offer at the time: strict avoidance of peanuts, and epinephrine shots in case of accidental exposure and allergic reactions. (FARE subsequently sold its stake in Aimmune for $47 million.) Aimmune followed a decades-old approach to tackling allergies, but one that hadn't yet been approved for any food allergies. Called immunotherapy, it involves exposing patients to gradually increasing doses of what they're allergic to, in hopes that their immune system can learn to tolerate it. Injections for people with allergies to bee venom, pollen, and pet dander have been around for years. Aimmune

After 8 hours of contentious discussion, an advisory committee to the United States Food and Drug Administration (FDA) endorsed the effectiveness of a first-of-its-kind peanut allergy treatment.

configured an oral immunotherapy for children allergic to peanuts, who number about 6 million in the United States. In the company's phase III clinical trial, participants gradually ramped up their dose, beginning at under one-500th of a peanut and flattening out at a maintenance dose equivalent to about one peanut. Although Aimmune is seeking approval to sell the treatment for use in 4- to 17-year-olds, one of its executives recommended at today's meeting that people taking its product continue indefinitely after their 18th birthday, to help them stay protected. Previous studies have shown that stopping oral immunotherapy can cause the immune system to revert a more highly allergic state, although this remains a topic of investigation.

A conundrum

The advisory committee, made up of academic and government scientists, faced a conundrum. Aimmune's treatment, AR101, helped children tolerate higher doses of peanut than before: Among the 294 highly allergic young people who completed its yearlong phase III study, 84% could tolerate two peanuts with no more than mild symptoms, and 63% could tolerate three. Assuming they continued on treatment, the company and doctors involved in the trials believed this meant that those young people were very likely better protected from what many of their parents fear the most—accidental exposure at school, birthday parties, friends' homes, and elsewhere. But advisory committee members worried that with AR101, patients were trading one risk for another. Because treatment means consuming the food proteins, they are allergic to, trial participants were much more likely to suffer an allergic reaction, like abdominal pain, vomiting, or an itchy mouth and throat, than children not in trials who practiced avoidance of peanuts. (Aimmune also recommends that even when successfully taking its therapy, avoidance of peanut products continue, and data on accidental exposures among those taking AR101 was limited.) A meta-analysis of a dozen trials of oral peanut immunotherapy found that the likelihood of needing epinephrine was roughly triple for patients on treatment versus those not. Among 709 people taking AR101 in two Aimmune trials, 74 needed at least one dose of epinephrine to prevent a reaction from escalating. Twenty percent of participants dropped out of the phase III study because of side effects. Furthermore, taking AR101 requires care: Exercise, hot showers, having a cold or a fever, menstruating, or being sleep deprived after ingesting a dose can all make an allergic reaction to the product more likely. In Aimmune trials, "The practice was to advise patients and families to be able to observe [children] for at least 2 hours" after a dose, said Stacie

Jones, chief of allergy and immunology at the University of Arkansas for Medical Sciences and Arkansas Children's Hospital in Little Rock, and one of the study investigators. "So not to put that child to bed, send to day care, [or] put on the bus" to school. The risk of an allergic reaction to treatment appeared highest in the early months of treatment, Aimmune executives noted, and the company is continuing to follow its volunteers. Still, some on the committee worried that even on the maintenance dose—which continues indefinitely—patients could react one day when they hadn't the day before. "Reactions occur unpredictably to previously tolerated doses," said John Kelso, a staff physician in allergy and immunology in the Scripps Clinic in San Diego, California. He was one of the two who voted against AR101's effectiveness; the other was Andrea Apter, who works in allergy and immunology at the Hospital of the University of Pennsylvania. "This is a lifetime treatment," she said, "and we don't have a lot of long-term data," including in adults. In one group of 310 people on a maintenance dose of AR101, nearly 9% experienced anaphylaxis, a type of allergic reaction that involves at least two body systems and is considered especially risky. Among those 310 people, 101 had an allergic reaction considered "moderate," and eight had a reaction deemed severe. There have been no deaths connected to the treatment.

Risk versus benefit

Parents, adults and children with peanut allergies, and advocates who spoke during a public hearing this afternoon contended the risks and hassle were more than worth it. "Many patients are willing to accept some risk of new treatments," said Lisa Gable, CEO of FARE. "That decision should lie with them." Gable and others also stressed the difference between reactions that are more predictable and occur in the context of treatment, and can quickly be addressed, and those that come out of the blue. Families also described the extreme anxiety they experience when raising an affected child. "Forty percent of parents believe their child has a very great chance of dying from a food allergy," said Pamela Guerrerio, chief of the Food Allergy Research Unit at the National Institute of Allergy and Infectious Diseases in Bethesda, Maryland, who provided an overview of current allergy treatment early in the meeting. In reality, deaths caused by food allergies are exceedingly rare, and annual estimates range from fewer than 10 to more than 150 in the United States. But the uncertainty around when peanuts will be encountered can be stressful. FDA's proposed a safety plan, if AR101 gets approved, calls for having caregivers or patients pledge that they will always carry injectable epinephrine while taking the drug. It also calls for administering a patient's first dose, and every

increased dose, in a "certified facility" that can treat allergic reactions. How facilities will become certified is still to be determined. As FDA moves to internal discussions, another peanut allergy treatment is coming down the pipeline: a skin patch by DBV Technologies, which submitted a licensing application to FDA last month. It will be considered for approval in the coming months.

Science, 13 September 2019

http://sciencemag.org/

A Doctor Explains The True Risk of 'Natural' Treatments Like Green Tea Supplements

2019-09-25

Recently, a patient came to me complaining of nausea, muscle weakness and fatigue. Her urine was tea-coloured despite drinking loads of water. A middle-aged woman, she seemed worried she had cancer or some deadly disease. Her lab tests revealed significant liver dysfunction. But her symptoms were not due to liver cancer, hepatitis or other disease. It turned out she had liver toxicity from a green tea supplement that she'd heard was a "natural" way to lose weight. When she stopped taking the supplement at my suggestion, her liver tests gradually normalised and she felt better over the course of a few weeks. I've seen the green tea issue in patients before and often witness the real-life pitfalls of eschewing traditional medicine, science and facts in favour of supplements, herbs and cleanses in the name of "natural" healing. In an effort to be healthy, patients can easily become ensnared in the potential dangers of alternative medicine or homeopathy. Let's be clear: Nature has a lot to offer patients. The Greek physician Hippocrates is said to have reported on the use of St. Johnswort, a flowering plant, for mood disturbances in the 5th century BC Digoxin, a well-studied medicine used to treat heart failure, is derived from the foxglove plant. Parkinson's patients are often commonly treated with the medication L-dopa, which comes from the plant Mucuna pruriens. Moreover, research repeatedly shows that consuming fruits and vegetables, getting adequate sleep and regular exercise, and spending time outdoors have myriad health benefits. But nature isn't always so well-intended. Refined sugar, a naturally occurring substance and one that lives in most Americans' pantries, is in large part responsible for our country's obesity epidemic. Simply because a substance comes from nature does not mean it is good for us. An important key to health is using nature appropriately. And in the case of my patient, she was able to lose weight when we made a clear plan to alter

Recently, a patient came to me complaining of nausea, muscle weakness and fatigue.

her basic human behaviours. Before she started taking the green tea extract, she was skipping breakfast, drinking the equivalent of two Venti coffees before noon, eating takeout meals for lunch, washing down her late-night dinner with two glasses of wine, sleeping restlessly, and spending too much time sitting and indoors. Green tea extract was never going to be the quick fix that she - and other patients I have seen - had hoped. It may be attractive as a natural cure for extra body fat, but this promise has not been shown in any studies, according to the National Centre for Complementary and Integrative Health at the National Institutes of Health. The key to helping my patient was pretty basic: looking at her lifestyle, her stress, and creating some structure and accountability for important lifestyle changes. While she wasn't able to eat like Gwyneth Paltrow would recommend (who can eat Pinterest-perfect meals like that as a mere mortal?), my patient took my advice to heart that she begin eating breakfast, packing healthy leftovers for lunch at work, cutting back the wine to weekends only, and getting more exercise on weekends. As a result, she started sleeping better and feeling more energetic. Eventually, the weight started coming off, too. Particular patients seem to be more susceptible to the lure of "naturopathic" medicine or homeopathy. Patients who have vague symptoms that do not fit tidily into a box, for example, are often the ones combing the Internet for answers to their health woes and spending hundreds of dollars on unproven and insufficiently regulated supplements and herbs. According to the 2012 National Health Interview Survey (NHIS), which included a comprehensive poll on the use of complementary health approaches by Americans, 17.7 percent of American adults had used a dietary supplement other than vitamins and minerals in the past year. That number is probably larger now: The total sales of herbal and dietary supplements in the United States were estimated to be more than US$8 billion in 2017, the 15th consecutive year of sales growth, according to a market research report. And women were more likely than men to use these products — as well as people with more education. Scientific data is often not the reason patients are drawn to herbal or "natural" supplements, Harvard School of Public Health researchers said. Of supplements users surveyed in 2001, 72 percent said they would continue using supplements despite a negative government scientific study. Patients reported getting much information about herbs from family, friends, advertisements and the Internet. My patients often consider herbal remedies to be free of side effects, but many "natural" products can lead to toxicity and can dangerously interact with prescription medications. Compounding the problem is that herbal and dietary supplements are not subject to the same strict regulatory standards as

prescription drugs. On its website, NIH's Office of Dietary Supplements says the products "are not required to be reviewed by the FDA for their safety before they are marketed because they are presumed to be safe based on their history of use by humans." Last year, another patient came in to see me complaining of fatigue, joint pains and abdominal bloating. She had seen a naturopath for these symptoms, who told her she had "chronic Lyme" disease and gave her multiple rounds of antibiotics and a bag full of daily herbal supplements. She said she didn't feel any better. When we met, she told me she was certain she had Lyme disease that wasn't being adequately treated. In fact, the antibiotics she had been given had only worsened her abdominal issues and caused a new problem: an intestinal infection that causes bad diarrhoea. After 10 days of appropriate antibiotic treatment, her diarrhoea was gone but she was back to her tired and achy self. At my recommendation, she stopped the supplements, and her fatigue abated somewhat. When we discussed her situation further, she revealed to me she suffered from a love-hate relationship with sugar. Like many of my patients, when she was stressed out, she binged on sugar. For most people, ingesting sugar provides a quick hit of the pleasure hormone dopamine, and for some people that rush of dopamine and the accompanying instantaneous boost of energy can become addicting. The problem is that a high sugar load causes a surge in the hormone insulin, which then results in a sudden drop in blood sugar - which can promote fatigue, weakness and irritability, among other symptoms. If consumed in excess over time, such dietary sugar can cause abdominal distress, bloating and joint aches. This is what was probably causing my patient's symptoms. So, we made a plan for her to not only cut back on sugar but also fill her diet with healthy stuff to get ahead of hunger and avoid binges. I also recommended she work with a therapist to deal with stress-eating. Her joint aches went away and her energy improved after about two weeks, and she continues to see a therapist for stress-eating issues. Food - and added support to use it properly - was the fix. Symptoms such as fatigue, headaches, joint pains and irregular bowel movements are some of the most common complaints I see in my office. They can be challenging for physicians to figure out, largely because they require careful and attentive listening by the doctor. And since more than 40 percent of patients do not tell their doctors about their use of complementary or alternative medicine (including 25 percent who take supplements and/or herbs), physicians can be bewildered when trying to pin down a root cause for a patient's complaints. Indeed, these patients are not easily diagnosed after a single lab test - and they are not easily fixed with a supplement. Occasionally, it takes time with the patient, careful attention to the patient's story, and asking the right questions to get to the

bottom of the problem. Often, the solution is right under our nose. Nature is indeed wonderful, but it doesn't always come in a pill.

*Lucy McBride is an internist based in the District.

Science Alert, 14 September 2019

http://www.sciencealert.com.au

Tainted, Toxic Skin Cream Sends Californian Woman Into Comatose State

2019-09-25

A Sacramento woman went to the emergency room in July with numbness in her hands and feet, slurred speech and trouble walking. The 47-year-old mother of five wasn't having a stroke or heart attack. She was suffering from mercury poisoning from a tainted anti-wrinkle cream imported from Mexico, KCRA-TV reported. She has been in the hospital since then, according to her son, who told KCRA he wished to remain unidentified. His mother, who also hasn't been identified, was initially able to respond to verbal commands before she entered her semi-comatose state. Olivia Kasirye, the public health officer for the Sacramento County Department of Health Services, told CBS Sacramento that the woman's cream contained methylmercury, a very toxic type of mercury. This is the first time a methylmercury poisoning from face cream has occurred in the United States, the department said in a statement. Kasirye is urging the public to immediately discontinue use of similar skin creams imported from Mexico because of how dangerous methylmercury is for adults and children. "We don't know whether this was an intentional change or whether there was a mistake in the person who was adding the mercury," she said, telling the station that there's an informal network of suppliers who bring the altered skin creams into the country. The most common way that people are exposed to methylmercury is through eating fish and shellfish that contain the toxin, according to the Environmental Protection Agency. Skin exposure to methylmercury can affect the central and peripheral systems, with symptoms including tremors, memory loss and cognitive and motor dysfunction, according to the World Health Organization. The average amount of mercury in blood is up to about 5 micrograms per litre as a result of mercury that is likely to be in someone's diet, according to the New York State Department of Health. The woman had 2,630 micrograms per litre in her blood, according to KCRA. "It can reach high levels in the blood, and it can also cross over into the brain," Kasirye told the station. "Once it crosses into the brain, even if you go to

A Sacramento woman went to the emergency room in July with numbness in her hands and feet, slurred speech and trouble walking.

the hospital, the medication we have cannot pull it out." The WHO and the Pan American Health Organization reported in 2017 that mercury was used in skin-lightening products for its ability to suppress melanin, resulting in fading hyperpigmentation, acne scars and overall skin tone. The FDA stated in 2016 that mercury-containing products were also sold as anti-wrinkle creams, and warned that cosmetic exposure could cause mercury vapor inhalation and mercury contamination through skin-to-skin contact. The agency also cautioned against skin care products manufactured abroad that are then sold, often illegally, in places that cater to Latino, Asian, African and Middle Eastern communities. The woman's son told CBS Sacramento that his mother knowingly used the altered product from Mexico twice a day for years because it worked better than the creams sold in drugstores. The woman purchased the cream from someone she knew, according to CBS Sacramento. Sacramento County Public Health and the California Department of Public Health will test similar creams in the Sacramento area for methylmercury. There have been more than 60 poisonings linked to foreign-branded, unlabelled or homemade skin creams tainted with a less-toxic form of mercury, according to a Sacramento County Department of Health Services statement. The department published a list of products that have tested positive for mercury on its website. Kasirye told KCRA that her department wants people to be careful about the products they buy, especially if they're not purchased from a drugstore. In November, 51 environmental and public health groups requested that Amazon and eBay get rid of illegal skin-care products containing high levels of mercury. In June, a judge in Alameda County Superior Court ruled that an advocacy group couldn't sue Amazon for selling skin-whitening creams that contain very high levels of mercury without the cancer warning labels usually required by law, according to the Mercury News. The judge agreed that Amazon wasn't responsible for warning labels on products listed by vendors. A court in Pennsylvania agreed with the ruling weeks later but held that Amazon could be held accountable for harmful effects of flawed products. (The Washington Post is owned by Amazon founder and chief executive Jeff Bezos.) There's no prognosis for the woman's condition, according to CBS Sacramento. "It was a huge slap in the face, honestly," the woman's son told the station. "You don't really expect something this severe to happen with just a face lotion."

Science Alert, 12 September 2019

http://www.sciencealert.com.au

Curiosities

Heartburn drug zantac may contain small amounts of known carcinogen, FDA says

2019-09-25

A substance that could cause cancer has been found in some ranitidine heartburn and ulcer medicines, including the brand-name drug Zantac, and the source of this contamination is being investigated, the U.S. Food and Drug Administration says. While preliminary tests found low levels of the nitrosamine impurity N-nitrosodimethylamine (NDMA) in some ranitidine products, the FDA said this does not mean patients taking the drugs should stop using them now. NDMA is the same contaminant found in many brands of blood pressure and heart failure medicines during the past year, leading to recalls. Patients who are taking prescription ranitidine and want to stop using it should discuss alternatives with their health care provider, the FDA advised. Those taking over-the-counter (OTC) ranitidine could switch to other OTC medicines. Several drugs are approved for the same or similar uses, the FDA noted. NDMA is an environmental contaminant found in water and foods, including meats, dairy products and vegetables. It is classified as a probable human carcinogen. "Drug impurities remain a major national concern," said Dr. David Robbins, associate chief of endoscopy at Lenox Hill Hospital in New York City. "While Zantac may prove safe in the long run, this latest statement adds confusion and concern, so my interim advice to patients is simple: switch to another drug … and of course, confirm with your doctor the need for an antacid." The FDA said it's evaluating whether the low levels of NDMA in ranitidine pose a risk to patients and that it will post that information when it's available. Sanofi, manufacturer of Zantac, did not respond to a request for comment. Dr. Janet Woodcock, director of the FDA's Centre for Drug Evaluation and Research, said the FDA is working with international regulators and industry partners to find out where the contamination originated. "The agency is examining levels of NDMA in ranitidine and evaluating any possible risk to patients," she said in a news release. "The FDA will take appropriate measures based on the results of the ongoing investigation." Large amounts of NDMA may pose a risk, but the levels of NDMA in ranitidine found in preliminary tests barely exceed amounts found in common foods, according to the FDA. Ranitidine decreases the amount of acid created by the stomach. OTC ranitidine is approved to prevent and relieve heartburn, and prescription ranitidine is approved for a number of uses, including treatment and prevention of ulcers of the stomach and intestines, and treatment of gastroesophageal reflux disease. Similar contamination in heart medicines is also under investigation. "The FDA has been investigating NDMA and other nitrosamine impurities in

A substance that could cause cancer has been found in some ranitidine heartburn and ulcer medicines, including the brand-name drug Zantac, and the source of this contamination is being investigated, the U.S.

blood pressure and heart failure medicines called Angiotensin II Receptor Blockers (ARBs) since last year," Woodcock said. "In the case of ARBs, the FDA has recommended numerous recalls as it discovered unacceptable levels of nitrosamines."

Medical Xpress, 13 September 2019

http://medicalxpress.com

Study of French postmen's testicles is an Ig Nobel winner

2019-09-25

There comes a time in a scientist's life when the surest route to global fame involves a bevy of naked French postmen with thermometers taped to their testicles. At least that is the case for Roger Mieusset, a fertility specialist at the University of Toulouse, whose unlikely studies have earned him one of the most coveted awards in academia: an Ig Nobel prize. Unlike the more famous – and rather more prestigious – Nobel prizes, which will be announced in Scandinavia next month, the Ig Nobels honour work that "first makes people laugh, and then makes them think". Ten awards were handed out on at the annual ceremony at Harvard University in the US, where an eight-year-old girl was on duty to enforce the one-minute rule on winners' speeches with the devastating line: "Please stop, I'm bored." Now in their 29th year, the awards included a chemistry prize for Japanese scientists who calculated how much saliva a typical five-year-old produces in one day (half a litre); an engineering prize for an Iranian inventor's nappy-changing machine; and an economics prize for Dutch researchers who discovered that banknotes can spread infectious microbes, and none more so than the Romanian leu. Italian scientists won the medicine prize for pursuing the idea that pizzas offer protection against death, a question they never quite managed to answer. Mieusset and his accomplice, Bourras Bengoudifa, recruited French postmen to settle a mystery that has received precious little attention: whether a man's testicles are both the same temperature. Having crunched the numbers from delicately placed sensors, Mieusset only deepened the mystery. According to his studies, the left one is warmer, but only when a man has his clothes on. Mieusset has invented heated pants for men to wear as an aid to contraception – he appears to be the sole purveyor of the unorthodox intervention. Britain's pride was upheld by Francis McGlone, a researcher at Liverpool John Moores University, who shared the Ig Nobel peace prize. As part of an international team, McGlone helped map out which parts of the body are most pleasurable to scratch. The ankles ranked highest, the researchers

The researchers taped thermometers to men's testicles to try to work out if both are the same temperature.

found, and then the back and forearm. "I was over the moon when I heard. It's nice for all of us. It's an honour," McGlone said on hearing he had won. "The thing that's fascinated me for a long while now is why is scratching an itch so bloody nice?" But there is a serious side to the research, he said. "People always laugh about itching, but chronic itch is devastating. People with chronic itch will scratch until it bleeds because the pain is preferable to the itching." By understanding which parts of the body are most prone to itch, and those which are most susceptible to relief, scientists hope to find new treatments for the condition. McGlone, who could not attend the ceremony, accepted the award in a video message recorded with a homunculus on his shoulder. As is standard for the annual event, winners pay their own way to Harvard, where the prizes are handed out by bona fide Nobel laureates. The winners each receive a cash prize: a now-obsolete $10tn bill from Zimbabwe. Patricia Yang and David Hu, both engineers at Georgia Institute of Technology in Atlanta, celebrated their second Ig Nobel prize at the ceremony. The researchers bagged their first in 2015 for discovering the "law of urination", which states that all mammals empty their bladders in about 21 seconds. This year, as part of a larger team, the two share the physics prize for working out how wombats make cube-shaped faeces. The feat, thought to be unique in the animal world, helps them construct stable piles of dung to mark their territory. Contacted about the prize, Yang said: "It solidifies my belief that curiosity brings joy and surprise in science." Other awards included the biology prize for a Chinese-led team that found that dead, magnetised cockroaches behave differently to living, magnetised cockroaches when studied with a quantum sensor; and the medical education prize for a US group that showed that acoustic clickers used in dog training also boost the skills of surgical students.

The Guardian, 13 September 2019

http://www.guardian.com

PTSD linked to increased risk of ovarian cancer

2019-09-25

Women who exhibit many classic symptoms of post-traumatic stress disorder (PTSD) may be much more likely to develop ovarian cancer than their counterparts who don't, a new study suggests. For the study, researchers asked women to identify the most stressful event of their lives and report whether they experienced seven different symptoms of PTSD. Women who suffered from six or seven PTSD symptoms were more than twice as likely to develop ovarian cancer as women who didn't report

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any of these symptoms, the study found. "We hypothesise that stress hormones directly affect cancer cells that may be in the body, causing them to grow faster and become more invasive," said Andrea Roberts, lead author of the study and a research scientist at the Harvard T.H. Chan School of Public Health in Boston. "It is also possible that chronic stress interferes with the body's ability to kill cancer cells," Roberts said by email. Ovarian cancer is the deadliest gynaecologic cancer and the fifth most common cause of cancer-related death among U.S. women, Roberts and colleagues note in Cancer Research. Animal studies have shown that stress and stress hormones can accelerate ovarian tumour growth, and that chronic stress can result in larger and more invasive tumors, researchers note. Previous research also suggests that mood disorders like depression and anxiety are associated with an increased risk of certain cancers. In the current study, researchers examined data on 54,710 women who participated in a health study of U.S. nurses from 1989 to 2015. Every two years, women were asked about any ovarian cancer diagnosis; in 2008 participants were also asked about any traumatic events they had experienced and any related PTSD symptoms. After up to 26 years of follow-up, 110 women had developed ovarian cancer. Overall, 15,378 women, or about 31%, didn't report any traumatic experiences like an assault or car accident. Another 9,482 women, or 19%, had been exposed to trauma but didn't report any PTSD symptoms. Almost 8% of the women did have a traumatic experience and four to five PTSD symptoms, and another 4.5% had a history of trauma and six or seven PTSD symptoms. While women with four to five PTSD symptoms appeared to have a higher risk of ovarian cancer than women with none, the difference was too small to rule out the possibility that it was due to change. The study wasn't a controlled experiment designed to prove whether or how traumatic events or PTSD symptoms might directly cause ovarian cancer. Still, the findings indicate that having higher levels of PTSD symptoms, such as being easily startled by ordinary noises or avoiding reminders of the traumatic experience, can be associated with increased risks of ovarian cancer even decades after women experience a traumatic event, researchers conclude. The study also found that the link between PTSD and ovarian cancer persisted for the most aggressive forms of ovarian cancer. Treating PTSD might help reduce the risk, Roberts said. "There was a suggestion in our data that women who no longer had PTSD were at lower risk than women with active PTSD symptoms," Roberts said. "We can't be sure from our study, but it may be that successful treatment for PTSD would reduce risk." Only about half of people with PTSD in the U.S. get treatment, Roberts noted. Beyond treating PTSD, women can also reduce their risk of ovarian cancer by quitting smoking, exercising

regularly, and losing some weight if they are overweight or obese, Roberts said. "Generally, though, the strongest risk factors for ovarian cancer (like having family members with ovarian or breast cancer, or having no children) are not things women are likely to be able to change," Roberts added.

Reuters Health, 14 September 2019

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

A numbing medicine turned a woman's blood blue

2019-09-25

A 25-year-old woman walked into an emergency department in Providence, Rhode Island, complaining of generalised weakness, fatigue, shortness of breath... and an unusual symptom you don't see every day. She was turning blue. Literally. Drs. Otis Warren and Benjamin Blackwood wrote about the case in a study published in the New England Journal of Medicine on Thursday. Their patient, they wrote, looked "cyanotic," the clinical term for appearing blue. They attributed her blueness to a numbing agent the woman was using, which deadens nerve endings in the skin. "She reported having used large amounts of topical benzocaine the night before for a toothache," the two co-authors wrote. Warren, an emergency medicine physician at Miriam Hospital in Providence, told CNN he'd only ever seen one other "blue" patient while completing his residency. It stuck with him, so he was immediately able to identify the woman's condition. "It's one of those rare cases that we're taught about, you study for, you take tests on, but you rarely ever see," he told CNN. Warren diagnosed her with "acquired methemoglobinemia," a reaction caused by certain medicines that stops blood from carrying oxygen to tissue, he said. Oxygen-rich blood is typically associated with a bright-red colour. But even though blood appears blue in patients with methemoglobinemia, oxygen levels are actually quite high, Warren said. Blood "selfishly binds" with oxygen and doesn't release it to the tissue where it's needed. And thus, the patient appears blue. It's fitting that the antidote is a brilliant blue, too. Methylene blue returns a missing electron to the haemoglobin molecule that restores oxygen levels and helps release oxygen back into tissue, he said. "In my field, emergency medicine, when you can cure a patient with a single antidote--that's a rare thing for us," he said.

A 25-year-old woman walked into an emergency department in Providence, Rhode Island, complaining of generalised weakness, fatigue, shortness of breath...

Numbing medication caused her reaction

In his patient's case, her reaction was caused by benzocaine, an active ingredient found in over-the-counter toothache and cold sore medicine. And while hers is a rare side effect, it warranted a warning from the Food and Drug Administration, which cautioned against its use in children under 2, who sometimes take the medicine to soothe teething pain. Warren's patient recovered after two doses of methylene blue and an overnight stay at the hospital. But when levels of the mutated blood rise 50% or higher, patients can enter a coma or develop heart and brain complications from the lack of blood to tissue. Any amount over 60% can cause death, he said.

CNN, 20 September 2019

http://www.cnn.com/health

Air pollution particles may reach foetuses in the womb, study finds

2019-09-25

New evidence has been found that air pollution can breach a mother's placenta and potentially reach foetuses in the womb, raising the possibility of future health problems. Researchers found that when pregnant women breathe in black carbon pollution -- created by the combustion of fossil fuels, such as in diesel-powered cars or the burning of coal -- harmful particles can make their way from the lungs to the placenta and may reach foetuses directly. Dirty air has previously been linked to increased miscarriages, premature births and low birth weights among infants, as a result of the effects of pollution on the mother. However, the placenta -- an organ that attaches itself to the womb during pregnancy, allowing oxygen and nutrients to pass from the mother's blood supply to the foetus through the umbilical cord -- was previously thought to be an "impenetrable barrier." A study last year was the first to suggest this wasn't the case, after pollutants were found in the placentas of five pregnant women in the United Kingdom. New research by scientists at Hasselt University and published Tuesday in the Nature Communications journal examined 25 non-smoking women who were giving birth in the Belgian city of Hasselt. Immediately after birth, the researchers collected the women's placentas to study the side facing toward the foetus -- where they found black carbon had accumulated. The more black carbon the women were exposed to during pregnancy, the more black carbon was found in the placenta. Black carbon particles come from a range of sources as well as cars and power plants -- biomass and coal stoves in households, kerosine lamps, and open burning of farmland for agriculture. The study

New evidence has been found that air pollution can breach a mother's placenta and potentially reach foetuses in the womb, raising the possibility of future health problems.

cautions that more research is needed to show whether once inside the placenta, the particles can travel to the foetus directly, but the results prove that placentas do in fact allow through particles like black carbon, providing "compelling evidence" for this theory. It's the latest step in research into the link between pollution and birth -- a 2017 report also found that exhaust fumes and soot from road traffic in London could be causing low birth weights in babies. The 2018 study, also conducted in London, found similar results to the Hasselt study -- but the particle composition hadn't been identified, and researchers could only speculate the pollution particles were carbon.

CNN, 18 September 2019

http://www.cnn.com/health

E-cigarette cancer warning as new study finds mint and menthol flavour risk

2019-09-25

E-cigarettes marketed at teenagers contain potentially cancerous levels of artificial flavouring, new research has found. The study of menthol and peppermint vapes revealed high concentrations of a carcinogenic additive called pulegone that US watchdogs recently banned in food. Even moderate use of the increasingly popular products - available in the UK in supermarkets, specialist stores and online - put users significantly outside the "safe" threshold. The tests were performed on e-liquids including the V2 Menthol and V2 Peppermint ranges, manufactured by WMR Products, a company since bought by Juul. The pulegone additive, a constituent of oil extracts from mint plants, is believed to cause liver cancer if absorbed in high enough quantities. While scientists behind the study do not know if pulegone is absorbed at the same rate through vaping as it is when eaten, they last night urged regulators to take precautionary action. It comes days after Donald Trump promised to ban flavoured e-cigarettes in an effort to prevent children taking up the habit, and England's Chief Medical Officer described vaping as "a ticking time bomb". Public Health England (PHE) encourages vaping as a means of quitting cigarettes and has argued that the habit is no more than five per cent as dangerous as smoking. However, the body is coming under mounting pressure to change its stance thanks to a spate of recent studies suggesting e-cigarettes may be dangerous. Simon Capewell, professor of public health at Liverpool University, said: "How many warning shots do the government need before it pauses to reconsider its gung-ho policy? "It seems every week we are getting new publications from independent

E-cigarettes marketed at teenagers contain potentially cancerous levels of artificial flavouring, new research has found.

researchers demonstrating additional risks from e-cigarettes. "Some of these flavours are proven carcinogens." Scientists at Duke University in North Carolina examined levels of pulegone in five e-liquids across three brands, and also one smokeless or "chewing" tobacco brand. Even "light use" - roughly equivalent in terms of frequency as 10 cigarettes a day - exposed vapers to considerably more pulegone than the US Food and Drug Administration has judged safe to ingest in food. The FDA has devised a "margin of exposure" scoring system, whereby anything below 10,000 is deemed potentially cancerous. The Duke researchers found light use of the V2 products yielded scores of between 1,290 and 3,084 for menthol, and 1,868 and 1,973 for peppermint. The products contained higher concentrations of pulegone even than menthol cigarettes, which have reduced their levels of the additive in recent years due to the health concerns. "Our analysis suggests that users of mint and menthol flavoured e-cigarettes and smokeless tobacco are exposed to pulegone levels higher than the FDA considers unacceptable for intake of synthetic pulegone in food, and higher than in smokers of combustible menthol cigarettes," the authors wrote. "Our analysis suggests that users of mint and menthol flavoured e-cigarettes and smokeless tobacco are exposed to pulegone levels higher than the FDA considers unacceptable for intake of synthetic pulegone in food, and higher than in smokers of combustible menthol cigarettes." Recent data from the stop smoking charity ASH showed that in 2019 15.4 per cent of 11 to 18-year-olds had tried vaping, an increase from 12.7 per cent in 2015. President Trump's pledge to ban flavoured e-cigarettes followed a handful of unexplained deaths linked to vaping in the US. Meanwhile a review by the London School of Hygiene and Tropical Medicine earlier this month found vaping may damage the heart. The practice remains a key component of PHE's efforts to eliminate smoking, however, and last week the agency invited the Independent British Vape Trade Association to its annual conference in Coventry. Two NHS hospitals in the Midlands opened vaping shops on their premises in a bid to help people quit smoking.

The Telegraph, 16 September 2019

http://www.telegraph.co.uk/news

"If the world isn't careful, renewable energy could become as destructive as fossil fuels," warns a recent article from Foreign Policy.

The Environmental Costs of Renewable Energy Are Staggering

2019-09-25

"The Limits of Clean Energy" is the title of an article by Jason Hickel in Foreign Policy, with the sub-title "If the world isn't careful, renewable

energy could become as destructive as fossil fuels." Here's the opening: The conversation about climate change has been blazing ahead in recent months. Propelled by the school climate strikes and social movements like Extinction Rebellion, a number of governments have declared a climate emergency, and progressive political parties are making plans—at last—for a rapid transition to clean energy under the banner of the Green New Deal. This is a welcome shift, and we need more of it. But a new problem is beginning to emerge that warrants our attention. Some proponents of the Green New Deal seem to believe that it will pave the way to a utopia of "green growth." Once we trade dirty fossil fuels for clean energy, there's no reason we can't keep expanding the economy forever. This narrative may seem reasonable enough at first glance, but there are good reasons to think twice about it. One of them has to do with clean energy itself. The phrase "clean energy" normally conjures up happy, innocent images of warm sunshine and fresh wind. But while sunshine and wind is obviously clean, the infrastructure we need to capture it is not. Far from it. The transition to renewables is going to require a dramatic increase in the extraction of metals and rare-earth minerals, with real ecological and social costs. In 2017, the World Bank released a little-noticed report that offered the first comprehensive look at this question. It models the increase in material extraction that would be required to build enough solar and wind utilities to produce an annual output of about 7 terawatts of electricity by 2050. That's enough to power roughly half of the global economy. By doubling the World Bank figures, we can estimate what it will take to get all the way to zero emissions—and the results are staggering: 34 million metric tons of copper, 40 million tons of lead, 50 million tons of zinc, 162 million tons of aluminium, and no less than 4.8 billion tons of iron.

FEE, 15 September 2019

http://fee.org

Silicosis advocates have welcomed a new code of practice for the stone benchtop industry in Queensland, but some say the measure is a "toothless tiger".

Silicosis advocates worried new industry code is a 'toothless tiger'

2019-09-25

Silicosis advocates have welcomed a new code of practice for the stone benchtop industry in Queensland, but some say the measure is a "toothless tiger". State Industrial Relations Minister Grace Grace announced the code of practice recently, a year to the day from when the government first reacted to the unfolding health crisis. The code provides an "enforceable" set of guidelines for the stone benchtop industry, but

silicosis patient advocate Roger Singh, from Shine Lawyers, said the fact no new regulatory powers were announced was disappointing. Silicosis advocates say vigilance is needed to prevent a new code of practice for the stone industry from being a "toothless tiger". "We welcome the new code, but there has to be more done to ensure it isn't a toothless tiger," Mr Singh said. "We have been calling for some months for a nation-wide solution to this issue, and a rigorous regulation of the stonemason industry to safeguard against adverse exposure." Ms Grace said the code "sets minimum and enforceable standards to ensure silica dust is managed safely and workers are protected". "The new code does not impose any new regulatory requirements on employers," she said. Industrial Relations Minister Grace Grace on Wednesday announced a new code of practice for the stone benchtop industry. "It simply complements the already stringent requirements of the Work Health and Safety Act and regulations." Mr Singh argued a national licensing regime should be implemented for the stonemason industry that would ensure safety standards were met. Silicosis is caused by tiny particles of silica dust being inhaled, causing irreversible damage to the lung tissues. Manufactured stone, which is used extensively in modern interior design such as kitchen and bathroom benchtops, can be up to 90 per cent silica, meaning stonemasons are most at risk, especially if they have not been given basic safety precautions such as a breathing mask and goggles. Earlier this year, Gold Coast stonemason Anthony White died from the disease, and his brother Shane Parata was diagnosed with silicosis a few days later. Trevor Torrens from the Silicosis Support Network said the new code was good news for workers in the future, but unfortunately did not reverse the damage that had already been done. "For workers already suffering with silicosis, this is a bit like the horse has bolted; they're thankful something's been done for their colleagues, but for them it's too little, too late," Mr Torrens said. "I'm confident employers will take the new code seriously, but it does require vigilance. "We're in this position because they weren't vigilant and didn't do the right thing in the first place - this code certainly strengthens their responsibilities, but again, their responsibilities were quite clear in the beginning as well." In total, 169 workers have been identified by Fair Work Queensland as having the lung disease, with 24 of those having developed progressive massive fibrosis as a result. Ms Grace said Workcover Queensland had funded 1000 health screens for current and former workers in the industry, and was working to establish clinical guidelines to help medical practitioners assess and manage those workers exposed to silica. "On the compliance front, we have completed 148 audits of all known engineered stone fabrication workplaces and 598 notices have been issued for offences such as dry cutting, poor dust control

and improper protective equipment," she said. "Sixteen infringement notices have also been issued, with fines totalling $54,000." The minister also confirmed audits of engineered stone fabrication workplaces were ongoing to ensure the code was being followed. The Queensland government has already set up a notifiable register of professional dust diseases including silicosis, while the federal government earlier this year announced $5 million for a dedicated taskforce to look at the issue.

The Age, 18 September 2019

http://www.theage.com.au

Children born to mothers with iron-deficiency anaemia early in pregnancy may be at higher risk for neurodevelopmental disorders, a new study suggests.

2019-09-25

In an analysis of data on more than half a million babies born in Sweden, researchers found that anaemia in the mother before the 30th week of pregnancy was linked with a heightened risk of disorders including autism, ADHD and intellectual disability. The study doesn't prove the anaemia causes these problems; it only shows an association. Still, said study co-author Renee Gardner, the findings suggest "it may be even more important than we have previously understood to boost low iron levels among women who are considering becoming pregnant or who are within the early weeks of pregnancy." That doesn't mean women should panic, said Gardner, who studies psychiatric conditions, substance use and social environment at the Karolinska Institute in Stockholm. "It's important to remember that while anaemia is common in pregnancy it's relatively rare that otherwise healthy women receive this diagnosis before the 30th week of pregnancy." Anaemia is more common later in pregnancy when iron demands of the foetus increase, Gardner said. But when the condition is found after 30 weeks, it's not associated with an increased risk of neurodevelopmental disorders, she added. Iron plays a role in the development of the nervous system, Gardner said. "For example, we know that it's important for neurons making new connections with other neurons and to build the protective coating on the outside of nerve cells that improve signal transmission." There are other ways low iron early in pregnancy could lead to developmental problems, Gardner said in an email. "Babies born to mothers who were diagnosed with anaemia earlier on tended to be smaller and were more likely to be born preterm," Gardner said. "The mothers were also more likely to have complicated pregnancies.

In an analysis of data on more than half a million babies born in Sweden, researchers found that anaemia in the mother before the 30th week of pregnancy was linked with a heightened risk of disorders including autism, ADHD and intellectual disability.

Curiosities

So, while it's possible that a lack of iron or other nutrients for a longer period of time during pregnancy directly influences the development of the brain on a molecular level, we also saw some evidence that the complications associated with anaemia, such as preterm birth and pre-eclampsia, could explain some of the increased risks that we observed." As reported in JAMA Psychiatry, Gardner and her colleagues analysed data from the Stockholm Youth Cohort, a registry of individuals born from 1984 through 2011 who were residing in Stockholm County at any point from 2001 through 2011. The rates of neurodevelopmental disorders were relatively low both in women with anaemia and those with normal iron levels. For example, autism was diagnosed in 4.9% of children born to women with anaemia early in pregnancy, 3.8% of those with moms diagnosed with anaemia later, and 3.5% of children whose mothers were anaemia-free during pregnancy. Similarly, ADHD was diagnosed in 9.3% of children with moms with anaemia early in pregnancy, 7.2% of those with moms with anaemia diagnosed later, and 7.1% of those with anaemia-free moms. Intellectual disability was diagnosed in 3.1% of children with mothers who had anaemia early in pregnancy versus 1.1% of those whose moms developed anaemia later on and 1.3% of kids born to moms without anaemia. Looked at another way, children born to women who had anaemia early in pregnancy were 1.44 times more likely to develop autism, 1.37 more likely to develop ADHD and 2.2 times more likely to have intellectual disability compared to children with moms who developed anaemia later in pregnancy. While the new study shows an association between anaemia early in pregnancy, "an association is not the same as causation," said Dr. Nevert Badreldin, an assistant professor of obstetrics and gynaecology at Northwestern University's Feinberg School of Medicine. "It's hard to assess, based on this information, whether the anaemia is in fact creating the association or whether the higher rates of neurodevelopmental disorders are related to something else the women (with anaemia early in pregnancy) have in common." Women should be reassured that the current guidelines recommend screening for anaemia at the first prenatal visit, Badreldin said. "So, the great majority of women are getting screened early," she added.

Reuters Health, 21 September 2019

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

Curiosities

Handwashing beats sanitiser for killing flu virus on hands

2019-09-25

Health workers who use hand sanitiser between patients may be more likely to spread flu germs than those who take the time to wash their hands, a recent experiment suggests. That's because fresh mucus from infected patients interferes with the ability of the alcohol in hand sanitiser to reach the concentrations needed to deactivate the flu virus, researchers report in mSphere. Previously, it was recognised that rubbing hands with sanitiser and handwashing with an antiseptic cleanser have similar disinfection effects against flu viruses, said Dr. Ryohei Hirose, an infectious disease researcher at Kyoto Prefectural University of Medicine in Japan who led the study. "However, in this study, we show that the physical properties . . . of mucus protect influenza A virus from inactivation by ethanol-based disinfectants," Hirose said by email. "This increases the risk of (active influenza virus) transmission, and hinders the eradication of healthcare-acquired infections." Researchers did a series of lab tests and computer simulations to examine how much active influenza A virus remained after exposure both to an ethanol-based disinfectant sanitiser and handwashing with an antiseptic cleanser. Influenza A is the most common form of seasonal flu. Flu virus in wet mucus from infected patients wasn't destroyed after two minutes of exposure to sanitiser - it took about four minutes for the virus to be completely deactivated. That compares to just 30 seconds with handwashing. To see how mucus might make it harder to fight the flu, researchers dabbed volunteers' fingers with either mucus or a saline solution containing the flu. Then they tested how long it took to deactivate the virus so it would no longer be contagious. The ethanol-based hand sanitiser could destroy flu virus in saline solution within 30 seconds. Sanitiser could also deactivate flu virus in dried mucus in a little under 8 seconds. But in moist mucus it took almost three minutes. The key to effectiveness was reaching an alcohol concentration of just over 30%, which happened more slowly in the gel-like consistency of fresh mucus. These results suggest that until infectious mucus has completely dried, active flu virus can remain on the hands and fingers even after using hand sanitizer, the study team concludes. Mucus containing the flu virus can take more than a half hour to dry, the experiments also found. Handwashing, however, could effectively destroy the flu virus in both wet and dry mucus quickly, the tests showed. One drawback is that the experiments don't reflect what would happen outside a laboratory setting when clinicians cleaned their hands between patients. Still, handwashing is the best approach when hands have mucus on them

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because alcohol-based sanitizer can't physically remove organic material, said Elaine Larson, a researcher at the Mailman School of Public Health at Columbia University in New York City. "Handwashing is the method of choice for physically removing anything from the hands by mechanically washing them down the drain rather than killing germs," Larson, who wasn't involved in the study, said by email. "Alcohols are preferable, better and faster, for actually killing germs but not removing dirt, residue or organic material," Larson added. "It is, however, clearly the best option whenever a sink and clean materials (soap, towels) are not available."

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

EPA Allowed Companies To Make 40 PFAS Chemicals Despite Serious Risks

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The chemical caused lab rats to lose weight. When pregnant rats were exposed to it, their pups lost weight, too, and their pups' skulls, ribs, and pelvises tended to develop abnormally. The compound, referred to by the number "647-42-7" in Environmental Protection Agency records, also caused discoloration of the teeth, increased liver weights, decreased how much their infants nursed, and lowered the animals' red blood cell counts. One report showed that the clear, colourless liquid caused "increased pup mortality" and, in adult rats, elevated death rates. Female rats exposed to 647-42-7 "did not appear normal," as another one of the reports explained, going on to detail their symptoms, which included "dental effects; mild dehydration; urine-stained abdominal fur; coldness to the touch; ungroomed coat; decreased motor activity; ataxia [uncoordinated movements]; periorbital [eye area] swelling; brown fur on the lower midline; hunched posture; and slight excess salivation." At one dose, the chemical caused ridges to form on one of the inner layers of the rats' incisor teeth, according to one of five reports DuPont sent to the EPA. Six other reports about the chemical submitted to the agency between 2007 and 2013 did not include the name of the manufacturer.

The chemical caused lab rats to lose weight.

Bad Chemistry

Despite the alarming findings of these animal experiments, between 4 and 40 million pounds of this PFAS compound were produced nationally in four locations in 2015, according to the most recent information available from the EPA. And 647-42-7, described in chemical companies' filings with

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EPA as a "reactant," is just one of 40 chemicals in the class of industrial compounds known as PFAS that are in active use despite the fact that their manufacturers alerted the EPA to substantial threats the chemicals pose to health and the environment. The chemicals were designated "active" on the EPA's inventory, meaning that they were made or used in the U.S. by at least one company between 2006 and 2016. DuPont was asked about the chemical and the risk reports it submitted to the EPA but declined to comment for this story. PFOS and PFOA, the two best known chemicals in a class that contains thousands, have been used made to make firefighting foam, Teflon, and hundreds of other products. After being recognized as a source of water contamination and linked to a wide range of health problems, including cancers, PFOA and PFOS were phased out of use in the U.S. between 2006 and 2015 along with other PFAS compounds based on chains of eight carbon atoms or more. During that period, the chemical industry began moving to "shorter-chain" alternatives, such as 647-42-7, which is based on six linked carbon atoms. These replacement compounds were promoted as safer and more environmentally sustainable. At a hearing before the House Committee on Oversight and Reform about corporate responsibility for PFAS contamination on September 10, Daryl Roberts, chief operations and engineering officer of DuPont, acknowledged the dangers of PFOA and PFOS when he "reaffirmed our commitment to not make, buy, or use long-chain PFAS materials." And Paul Kirsch, chief executive officer of Chemours, which spun off from DuPont in 2015 and inherited its PFAS business, said that the company "supports EPA's process to determine whether legacy long-chain PFAS chemicals should be designated as hazardous substances under the Superfund law." Yesterday, appearing before the House Committee on Transportation and Infrastructure, Dave Ross, assistant administrator in EPA's Office of Water, promised that the agency "will propose a regulatory determination" for PFOS and PFOA. Yet as these reports make clear, the short-chain PFAS compounds that remain in use present many of the same threats associated with longer-chain molecules. Manufacturers filed at least one report of substantial risk with the EPA for each of these 40 compounds, according to The Intercept's analysis of documents accessed through the agency's website. 3M submitted reports for 21 of these chemicals; DuPont submitted the reports for most of the rest. Some chemicals were the subject of more than a dozen reports. The specific risks associated with these 40 PFAS chemicals — and the fact the EPA has had hundreds of reports documenting them for years, and in some cases, decades — has not been previously reported. All PFAS chemicals persist indefinitely in the environment and have the potential to contaminate water and remain in the bodies of people and animals. But these compounds presented

additional risks that, once discovered, required their manufacturers to report them to the EPA. Among the health effects on lab animals noted in the reports were neurotoxicity; developmental toxicity; decreased pup weight; decreased conception; testicular, pancreatic, and kidney cancers; severe convulsions; bleeding in the lungs; tooth problems; post-natal loss; hair loss; and depression of sperm function. Ideally, the findings in these animal studies would have led to more testing, according to Laura Vandenberg, a toxicologist and associate professor at the University of Massachusetts Amherst School of Public Health and Health Sciences who reviewed several of the reports found by The Intercept. Vandenberg cited one study, in which rats began to show "sudden movements characterised by pronounced jumping" after being exposed to one of the compounds. "As a consequence of the pronounced jumping, the snout/limbs of Group 3 rats were observed to protrude through the bars of the confinement cage, resulting on occasions in a trapped snout," according to the report, which 3M submitted to the EPA in 2000. "That's a very severe outcome," said Vandenberg. "It should have been used as a trigger to study lower doses and more subtle outcomes." Still, many of the harms associated with the chemicals in the reports did not surprise Vandenberg, who said they were very similar to the effects of PFOA and PFOS seen in animal experiments. "What is shocking is that the concern that came after learning the effects of PFOA and PFOS isn't being transferred to these other perfluorinated chemicals," she said. "These chemicals are being introduced as if they're safe as replacements when in fact they're not and someone else knew that they weren't." Despite their dangers, at least 15 of these 40 PFAS compounds that were the subject of substantial risk reports are not only on the most recent list of compounds in active use but also, like 647-42-7, are produced in very large quantities. While most manufacturers withheld the exact amount of the chemicals they produced, on the grounds that the information is confidential and that its disclosure would harm their businesses, these 15 were included on a list compiled by the EPA of compounds produced or imported in excess of 25,000 pounds per year in a single location. Such amounts have the potential to profoundly alter human biology, according to Philippe Grandjean, a toxicologist and adjunct professor of environmental health at Harvard University. "A tiny speck could seriously impact the health of a person," said Grandjean, whose research has shown that very low levels of the chemicals depress children's immunity. Even if each of the manufacturers of 647-42-7 made the smallest amount in the range of production volumes they reported — which would total 4 million pounds in a single year — that quantity is more than the weight of all PFAS

accumulated in the blood of everyone in the United States, according to Grandjean.

7,757 Secret Chemicals

Among the newer generation of PFAS replacements made in large quantities is GenX, DuPont's substitute for PFOA. Like the chemical it replaced, GenX causes cancer and other diseases in lab animals, as The Intercept was first to report in 2016. That chemical has since been found in the drinking water of some 250,000 people in North Carolina. Other chemicals used in large quantities since longer-chain PFAS have been phased out appear to present similarly alarming risks, but haven't yet made it onto the radar of regulators in part because the studies are not included in the published literature. Consider one compound that looks and behaves much like the PFAS chemical 3M previously used to make the fabric and carpet protector Scotchgard, but is based on a four- rather than eight-carbon chain. Beyond their structural and functional similarity, this new compound shares something else with its chemical predecessor: alarming health effects. "Mortality was observed at all doses," explained an EPA summary of studies of the chemical that were submitted to the agency by 3M between 2002 and 2017. In one of the experiments, the compound interfered with the development of baby rats' skulls, ribs, and foot bones. The more of the compound the rats were exposed to, the more severe the interference was, one of the surest signs that the chemical was responsible for the problems. In another experiment, the compound harmed the livers, kidneys, and bladders of both male and female rats. Because the bladder damage occurred at even the lowest doses given the lab animals, the researchers determined they were not able to set a level at which the chemical had no effects.

"Mortality was observed at all doses."

The compound was included on the 2012 and 2016 lists of chemicals made in large volume but was not on the list in 2002 and 2006, before the phase out of longer-chain PFAS was complete. Although 3M submitted several reports documenting the chemical's toxicity to rats and their developing pups, no information was available about where it is made or used, by whom, for what, or in what quantities— because all of that information, including the name of the company itself, was removed as confidential business information. In some cases, companies have declared the very existence of chemicals confidential. In the EPA's most recent inventory of chemicals, which was released in March 2019, 7,757 active compounds were on a list that is entirely kept from the public,

making it impossible to locate risk reports or any other information about them. While it's not clear how many of these mystery chemicals are in the PFAS family, "it's almost certain that there are a lot of PFAS on the confidential part of the inventory," said Richard Denison, lead senior scientist at the Environmental Defence Fund. That means that many more PFAS chemicals beyond the 40 compounds mentioned in this story have likely been the subject of risk reports that aren't available. Companies are also allowed to shield the identities of their products on the list of chemicals made in large quantities, meaning that many more than 15 PFAS compounds may be produced on a massive scale, though it's impossible to know how many, where, or in what volumes. Historically, there were few requirements for adding chemicals to this secret list. "Companies simply asserted the identity of a chemical to be confidential and EPA would never review that claim," said Denison. A 2016 update of TSCA, the law regulating toxic chemicals, tightened up the requirements for shielding the identity of chemicals. But so far, those improvements have not yet materialised, according to Denison. "Under the Trump admin, the EPA has been exceedingly slow in implementing these new requirements."

Nobody's Looking for Them

If scientists had information about where the compound was made and used, they could know where to check for environmental contamination. Evidence from Parkersburg, West Virginia, and Carneys Point, New Jersey, and some of the other places where hundreds of facilities emit PFAS show that manufacturing and using the chemicals can be a messy business, and the chemicals often seep into nearby soil and water. Yet even when the location of a production site is known, it is not clear that anyone is looking for these compounds. Several of the companies that make PFAS in large volumes have supplied the addresses of their sites. Two of the chemicals, including one described as "neurotoxic at all levels," had a 3M facility in Rock Island, Illinois, listed as their production site in the most recent EPA records. Yet the EPA doesn't appear to have asked the company to test for either of these chemicals or their breakdown products at the plant. In 2006, the agency did ask 3M to look for PFOA and PFOS in water at the plant. While the company found both of those chemicals at high levels in every spot it looked for them and had already measured them in alfalfa grown at the facility — indicating that the water contamination could lead to food contamination — 3M was no longer making PFOA and PFOS in 2006. It was, however, making this other PFAS compound in large quantities — and, according to EPA documents, still was as of 2016 — but apparently has not been required to look for it. In

response to an inquiry about this story from The Intercept, 3M provided the following statement: "3M regularly and proactively examines the environmental and health impacts of our products, including our PFAS materials. We work closely with the EPA and state and local regulatory agencies to provide appropriate monitoring, testing and public reporting around our manufacturing sites. We have more information on other recent actions we've taken around PFAS stewardship at www.3M.com/PFAS." 3M did not respond to questions about whether it had looked for or found this particular compound in the water near its Rock Island facility — or whether it had done so for three other PFAS chemicals it reported to the EPA. So far, the EPA's search for PFAS contamination has been limited to a few better-known compounds in the class. The only national survey conducted by the agency looked for six PFAS chemicals, none of which are still produced in large quantities. There is no national environmental surveillance program for these newer compounds. And, with the exception of GenX, state regulators haven't been testing for most of them. The Minnesota state agency responsible for addressing water pollution hasn't looked for a PFAS compound that, according to the most recent EPA records, was being produced in large quantities at a 3M facility in Ramsey, Minnesota. The chemical had pronounced reproductive effects, according to a 2003 report 3M submitted to the EPA, which found that for pregnant rats given the highest doses of the compound "the number of liveborn pups was significantly decreased and the number of stillborn pups was significantly increased". But the Minnesota Pollution Control Agency couldn't test water for it because it wasn't aware that the chemical was made in its state. "There's no ability for us to say, 'Hey 3M, just give us the whole list of what you're making,'" said Summer Streets, an environmental chemist at the Minnesota Pollution Control Agency. Instead the state agency relies on EPA to learn about what's produced at the plant. And many of the critical details in the documents it receives from the EPA have been withheld on the grounds that they're confidential business information, according to Streets. "That gets in a way of a lot of work," she said. "We're forever behind the eight ball."

The Honour System

Since 1976, the Toxic Substances Control Act has required companies that make, process, or distribute chemicals to immediately report to the EPA information that "reasonably supports the conclusion" that a chemical presents a substantial risk to health or the environment. But the reporting works on the honour system; companies have no requirement to look for this evidence of harm. And there is no way to know whether they

send in all they have. If the EPA discovers after the fact that companies have withheld damning information, it can fine them, as the agency did in 2005 and 2006 after realizing that both 3M and DuPont had kept evidence of the health threats of PFOA and PFOS secret for years. But the amounts of the fines the companies faced were miniscule compared to their profits. If companies do perform tests and report their results to the EPA, the agency doesn't necessarily have to do anything in response. By law, the regulators can seize the substance, order more testing, restrict its manufacture, or begin the process of banning it — but they don't have to do any of these things and almost never do. In the case of the vast majority of the hundreds of PFAS compounds that are still made and used in this country, the agency has done little. One step the EPA has taken with new PFAS compounds, whether they've been the subject of risk reports or not, is to enter into legal agreements known as consent orders that limit how companies handle new chemicals they're introducing to the market. The EPA has issued more than 200 consent orders for new PFAS compounds since 2002, most of which note that the new chemical "may present an unreasonable risk of injury to human health and the environment" and that there may be "significant (or substantial) human exposure to the substance and its degradation products." Despite this worrisome combination, the agreements allow the chemicals into commerce. And because the consent orders are often heavily redacted, it's extremely difficult to figure out whether the restrictions they apply are being violated. In a 2010 consent order for a PFAS compound used to manufacture paint and coatings, for instance, the EPA required further testing of the chemical once the company produced a certain amount of it, but because that number is redacted, and because the company also declared the amount of the chemical it produces confidential, it's impossible to determine whether the testing should have been done. There's good reason to worry about whether this PFAS compound has made its way into drinking water. In animal experiments, the chemical, which "may be used as a major substitute for PFOA," as the consent order notes, had effects on rats' thyroid, livers, and nasal tissues. Abnormalities were also found in some of the tests of male rats exposed to the compound, which the consent order noted was a "sign of concern for male reproductive toxicity." Despite these red flags, the compound was made in large quantities at a Chemours facility in Deepwater, New Jersey, according to the most recent information on its production, which EPA issued in 2016. Chemours did not respond to multiple requests to comment for this story. The New Jersey Department of Environmental Protection was asked whether it monitored soil or water for contamination from the compound near the Chemours plant in Deepwater but did not

reply. Even when a consent order limits how much of a chemical can be released into the environment, it's exempt from that restriction if the chemical is a by-product of another process rather than being produced to be sold. This loophole allowed DuPont to freely emit GenX into the Cape Fear River in North Carolina, even though the company had entered into a consent order with EPA that strictly limited its release as a product. "It's just loophole upon loophole upon loophole," said Eve Gartner, a staff attorney at Earthjustice who works on toxic chemicals. Gartner called EPA's handling of PFAS "an unmitigated disaster" and said that the agency had failed to use its full power under the law. "EPA could have used its authority in a meaningful way to stem the tide of these chemicals into commerce, the environment and human bodies. And instead it has taken tiny baby steps that have really not been protective," she said. "This is a crisis that we will be dealing with for millennia." According to an EPA spokesperson, the agency has taken steps to restrict the entry of new PFAS onto the market. Since 2006, companies have withdrawn their applications to introduce new PFAS compounds in the class on 44 occasions while they were under EPA review. The EPA has also denied 49 applications for low-volume exemptions for PFAS, which allow the companies to begin producing less than 10,000 kilograms per year of a substance without having to undergo a full safety review. Rather than leading to more research or serving as justification for EPA to forbid the compounds from entering the market, it seems that most of these risk reports were simply filed away. Although they were technically accessible through the EPA website, the specific risks posed by the replacement PFAS chemicals have gone unnoticed by regulators, scientists, and the general public. In the meantime, some of these compounds have spread into the environment. An article published in Ecotoxicology and Environmental Safety in June noted that seven PFAS replacement compounds were found in 19 rivers in China, the United States, Germany, the United Kingdom, the Netherlands, Sweden, and Korea. The chemicals have also already been detected in fish, frogs, seals, polar bears, and killer whales. And though little research has yet been done in the area, a few scientists have already measured replacements PFAS in human blood. One 2017 study found 3M's PFOA replacement, ADONA, in people living in South Germany. Researchers have found several replacement PFAS chemicals in people living near a Chemours plant in Fayetteville, North Carolina. And one of the compounds is now widespread in women and foetuses in China. Had they been made widely available; researchers might have been able to investigate whether people exposed to the chemicals responded the same way the lab animals did. It's a question that keeps Hope Grosse up at night. Grosse grew up near a military base in Pennsylvania where multiple PFAS compounds

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contaminated her drinking water. She was diagnosed with cancer at 25, and she and her sister have struggled with autoimmune problems. She and her older brother are also missing several teeth, and two of her children, who also grew up near the base, have severe dental problems. Everyone in her family has teeth that crumble easily and her 20-year-old daughter, whose dental care has cost the family more than $300,000, is missing 16 teeth. There is no way to know for sure whether her family's dental issues or other health problems are due to the chemicals. But when told that several of the risk reports PFAS manufacturers submitted to EPA documented the chemicals' dental effects, including alterations to the "mineralisation of dentin," one of four substances that comprise teeth, and "the enamel space of the incisor teeth," Grosse was dismayed. "It would be a violation of scientific ethics to submit humans to experiments," said Grosse. "Yet the continued use of these chemicals without further testing has been an experiment on us."

The Intercept, 20 September 2019

https://theintercept.com

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