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

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ASIA PACIFIC

Indonesia USDA FAIRS Country Report

2020-02-11

On February 11, the USDA's Foreign Agricultural Service published a Food and Agricultural Regulations and Standards (FAIRS) report for Indonesia

USDA FAIRS Country Report

https://apps.fas.usda.gov/newgainapi/api/Report/DownloadReportByFileName?fileName=Food%20and%20Agricultural%20Import%20Regulations%20and%20Standards%20Country%20Report_Jakarta_Indonesia_12-31-2019

22 October 2019

Consultation on draft legislation for the National Standard for Environmental Risk Management of Industrial Chemicals

2020-02-13

The consultation package includes the draft Commonwealth legislation, examples of supporting instruments, and explanatory materials

Consultation is now open on a draft legislation package for the National Standard for Environmental Risk Management of Industrial Chemicals (the National Standard). Submissions can be made until 5pm 21 February 2020.

The National Standard has been developed by all Australian governments to efficiently and effectively manage the impacts of industrial chemicals on the environment, while providing consistent requirements for businesses across Australia.

The development of draft legislation for the National Standard builds on stakeholder consultation over a number of years and fulfils the shared commitment made by all Australian environment ministers.

The consultation package includes the draft Commonwealth legislation, examples of supporting instruments, and explanatory materials.

On February 11, the USDA's Foreign Agricultural Service published a Food and Agricultural Regulations and Standards (FAIRS) report for Indonesia

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Stakeholder feedback is requested on the exposure draft package by 5pm 21 February 2020. Individuals and organisations can provide comments on all or parts of the package.

Australia Department of the Agriculture, Water and the Environment,
February 2020

<https://www.environment.gov.au/protection/chemicals-management/national-standard/draft-legislation>

AMERICA

Are There Nano- and Microplastics in the Workplace?

2020-02-19

The growing problem of plastic pollution in the environment is receiving an increasing amount of attention. Small particles of plastics are often referred to as microplastics (plastic particles smaller than 5 mm [1]) and nanoplastics (the nanoscale fraction of plastic particles). Nano- and microplastic particles (NMPPs) can be formed through environmental and mechanical degradation (the top-down mechanism). They can be also generated through condensation of molecular species, for example, during heating or burning of plastics (the bottom-up mechanism).

A lot of attention is focused on the presence of NMPP in the food chain. A critical issue from an occupational health perspective is how workers might be exposed to NMPPs. Do they become airborne? If NMPP are airborne, the main route of exposure in the workplace is through inhalation.

To read the full article: https://blogs.cdc.gov/niosh-science-blog/2020/02/19/microplastics/?deliveryName=USCDC_170-DM20315

CDC, NIOSH Science Blog

https://blogs.cdc.gov/niosh-science-blog/2020/02/19/microplastics/?deliveryName=USCDC_170-DM20315

Addition of Certain PFAS to the TRI by the National Defense Authorization Act

2020-01-01

Section 7321 of the National Defense Authorization Act for Fiscal Year 2020 (NDAA) adds 160 per- and polyfluoroalkyl substances (PFAS) to the list of

If NMPP are airborne, the main route of exposure in the workplace is through inhalation

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chemicals covered by the Toxics Release Inventory (TRI) under Section 313 of the Emergency Planning and Community Right-to-Know Act (EPCRA).

Key Information

TRI PFAS List

List of PFAS Added to the TRI by the NDAA

PFAS additions are effective as of January 1, 2020. Reporting forms for these chemicals will be due to EPA by July 1, 2021, for calendar year 2020 data.

TRI reporting requirements apply to these PFAS (e.g., supplier notification) and TRI reporting exemptions, if applicable, are available for these chemicals.

The NDAA establishes TRI manufacturing, processing, and otherwise use reporting thresholds of 100 pounds for each of the listed PFAS.

EPA will soon revise the EPCRA Section 313 list of reportable chemicals in the Code of Federal Regulations (CFR) to include the 160 PFAS added by the NDAA.

Additional Background

On December 20, 2019, the NDAA was signed into law. Among other provisions, Section 7321 adds certain PFAS to the EPCRA Section 313 list of reportable toxic chemicals as of January 1, 2020. Specifically, the NDAA identifies 14 chemicals by name and/or Chemical Abstract Service Registry Number (CASRN) in Section 7321(b) and identifies additional PFAS based on the following criteria:

“(i) listed as an active chemical substance in the February 2019 update to the TSCA Inventory under section 8(b)(1) and (ii) on the date of enactment of this Act, subject to the provisions of—

(I) section 721.9582 of title 40, Code of Federal Regulations; or

(II) section 721.10536 of title 40, Code of Federal Regulations.”

EPA has reviewed the above-listed criteria and found 158 chemicals that meet the requirements of this part of the NDAA. Twelve of these are among the 14 PFAS specifically listed in the NDAA; with the addition of the other two, there are a total of 160 PFAS subject to listing under the NDAA. The names and CASRNs for some of the chemicals listed under 40 CFR 721.9582 and/or 40 CFR 721.10536 are subject to a claim of protection

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from disclosure. Under Section 7321 of the NDAA, EPA must review any such chemicals before the chemicals are added to the TRI list (NDAA Section 7321(e)). Therefore, the chemicals that are subject to a claim of protection from disclosure will not be added to the EPCRA Section 313 toxic chemical list until EPA completes the process provided by Section 7321(e) of the NDAA.

As established by the NDAA, the addition of these PFAS is to be effective January 1 of the calendar year following the date of enactment of the NDAA. Accordingly, these 160 PFAS are reportable for the 2020 reporting year (i.e., reporting forms due July 1, 2021). EPA will be revising the EPCRA Section 313 list of reportable chemicals in 40 CFR 372.65 to include the 160 PFAS added by the NDAA.

The NDAA established a manufacture, processing, and otherwise use reporting threshold of 100 pounds for each of the listed PFAS. Therefore, EPA will be amending the regulatory text to indicate that the reporting thresholds for the listed PFAS are 100 pounds.

Additionally, the NDAA provides a framework for PFAS to be added automatically to the TRI list on January 1 of the year following certain EPA actions (NDAA Section 7321(c)). For example, the NDAA automatically adds a PFAS to the TRI list in response to the EPA finalizing a toxicity value for it. Lastly, the NDAA instructs EPA to consider certain other PFAS to the TRI list for possible addition (NDAA Section 7321(d)). EPA published an Advance Notice of Proposed Rulemaking (ANPRM) on December 4, 2019, to gather information for use in a potential rulemaking to add certain PFAS to the TRI chemical list. While the NDAA adds certain PFAS to the TRI chemical list, there are additional PFAS that were not added by the NDAA. Through the ANPRM, EPA continues to solicit comment on PFAS generally as they relate to TRI reporting, including comment on appropriate reporting thresholds, categorization of PFAS, availability of information on human health and environmental toxicity, persistence, and bioaccumulation of PFAS of these additional PFAS that would help determine if they meet the statutory criteria for inclusion on the TRI list of chemicals.

US EPA, January 2020

<https://www.epa.gov/toxics-release-inventory-tri-program/addition-certain-pfas-tri-national-defense-authorization-act>

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Alaska Leads U.S. In Releasing Toxic Chemicals

2020-02-19

Not so fast says the Alaska Department of Environmental Conservation (DEC) in response to a new report from the U.S. Environmental Protection Agency (EPA). The report states that Alaska led the nation in releasing toxic chemicals tracked by the agency in 2018, according to an article from the Juneau Empire. The DEC says those numbers don't tell the whole story.

According to the article, 30 facilities across the state released 971.9 million pounds of Toxic Release Inventory (TRI) chemicals in 2018 – reportedly the most in the U.S. by volume. DEC Commissioner Jason Brune notes that the vast majority of that release are land releases related to mining and don't have a significant impact on public health. The EPA published a guide to help explain metal mining data alongside the report that acknowledges TRI data "is not in itself enough to determine the level if any of public exposure to toxic chemicals" because large mines relocate millions of tons of excavated waste rock.

Read the entire article [here](#).

Chemical Processing Staff, 19 February 2020

https://www.chemicalprocessing.com/industrynews/2020/alaska-leads-u-s-in-releasing-toxic-chemicals/?utm_source=hs_email&utm_medium=email&utm_content=83611339&_hsenc=p2ANqtz-96zqysHhtWLaOdo_skGI46iCsvtx0SFe8c0Rg_0ugs1fKk0N_vwOYutAxUPMsJ61UoaPZYHY-0ood1L1IYwOdGg7whHt7WhTD0qnViC809LnUZSY&_hsmi=83611339

Not so fast says the Alaska Department of Environmental Conservation (DEC) in response to a new report from the U.S.

EUROPE

ECHA starts work on making drinking water safer

2020-01-14

ECHA/PR/20/01

ECHA will start to compile a list of substances that can be safely used in materials that come into contact with drinking water. The aim is to improve consumer protection and ensure equal safety standards for industry.

Helsinki, 14 January 2020 – With the recast of the Drinking Water Directive, ECHA has been given a task to compile and manage an EU positive list

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of chemicals that can be safely used in materials that come into contact with drinking water. The first positive list is expected to cover around 1500 chemicals and will be adopted by the European Commission by 2024.

As the first EU positive list will be based on the existing lists in the Member States, a review programme will be introduced through which the Agency will reassess all substances on the list within 15 years from its publication. ECHA will prioritise substances for the systematic review and recommend expiry dates for them. Each approved substance will be authorised for use for a limited period of time. The timing of the reviews will be based on the hazardous properties of the substances as well as the quality of and how up to date underlying risk assessments are.

Companies will need to submit a review application to ECHA if they want to keep their substances on the positive list. Companies will also need to submit an application if they want to add new substances to the list. Member States can also submit dossiers to ECHA to remove substances from the list or to update entries – for example, when a concentration limit for a substance in drinking water changes. ECHA will assess applications and dossiers and its Committee for Risk Assessment will form its opinion for further decision making by the Commission.

Bjorn Hansen, ECHA's Executive Director says: "We will assess substances used in materials to produce, for example, water pipes and taps, and look forward to working to help improving the quality of drinking water throughout Europe. Hereby, we can rely on our expertise in risk assessment, achieve efficiencies and ensure consistency across different pieces of chemicals legislation. Harmonising the assessment also ensures a level playing field for companies providing these materials across different European countries."

ECHA will support the Commission in developing information requirements for applicants and assessment methods. This work will be done in close collaboration with the European Food Safety Authority (EFSA) due to the close links with food contact materials.

Background

The provisional agreement on the recast of the Drinking Water Directive was reached on 18 December 2019 and is still subject to formal approval by the European Parliament and the Council. Following approval, the

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Directive will be published in the EU's Official Journal and enter into force 20 days later.

ECHA, 14 January 2020

<https://echa.europa.eu/de/-/echa-starts-work-on-making-drinking-water-safer>

Study measures PFAS in UK food packaging

2020-02-13

Fidra publishes report testing for presence of per- and polyfluoroalkyl substances (PFAS) in 92 samples of fiber-based food packaging from UK supermarkets and take away restaurants; finds 18 have total organic fluorine levels above background concentration; highest concentrations in molded fiber take away boxes.

The Scottish non-governmental organization Fidra has published a report on measuring per- and polyfluoroalkyl substances (PFAS) in fiber-based food contact materials (FCMs) sampled from major UK supermarkets and restaurants. The organization collected 92 samples of FCMs between October and November 2019 from 41 UK take away restaurants and 51 supermarkets. This included packaging such as bakery bags, pizza boxes, takeaway bags, and molded fiber takeaway boxes. All samples were first screened using droplets of olive oil to see if spherical droplets occur, as this can be interpreted as pointing to the likely presence of a PFAS lining. 20 of the collected samples tested positive (i.e., where spherical droplets did form) and were subsequently sent for laboratory analysis to determine total organic fluorine content. A concentration of 10 $\mu\text{g}/\text{dm}^2$ dry weight (dw) was used to distinguish between background contamination and the addition of PFAS. The testing revealed products containing PFAS present in 8 of 9 major UK supermarkets and in all of the takeaway restaurants tested. 18 of the 20 tested samples had fluorine concentrations higher than background levels, ranging from 19.3 $\mu\text{g}/\text{dm}^2$ dw in one of the takeaway bags, to 3,480 $\mu\text{g}/\text{dm}^2$ dw in a molded fiber takeaway box. The highest PFAS content was consistently found in molded fiber takeaway boxes.

The study concludes that PFAS are clearly present in food packaging on the UK market with a widespread use among product types. The authors "recommend individuals looking to lower their exposure to PFAS and minimize their environmental impact avoid the unnecessary use of disposable food packaging, favoring reusable containers wherever appropriate." Further they recommend "supermarkets and takeaway outlets act towards phasing PFAS out of food packaging," that

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“compostability standards lower their accepted PFAS content to no more than what can be considered background contamination,” and for group-based chemical legislation to prevent the addition of PFAS to food packaging.

Read More

Fidra (February 11, 2020). [“Forever Chemicals in the Food Aisle.”](#)

Julie Schneider (February 11, 2020). [“New investigation finds harmful PFAS chemicals in UK food packaging.”](#) CHEM Trust

Reference

Fidra (February 11, 2020). [“Forever chemicals in the food aisle: PFAS content of UK supermarket and takeaway food packaging.”](#) (pdf)

Food Packaging Forum, 13 February 2020

<https://www.foodpackagingforum.org/news/study-measures-pfas-in-uk-food-packaging>

Scan4Chem

2020-02-14

The free-of-charge app for checking substances of very high concern (SVHCs) in products like clothing, sports equipment, toys etc. Use the app to scan the barcode of a product and send a request to the producer or retailer to obtain information about the presence of SVHCs in that product above a 0.1% threshold.

How it works

Just scan it!

Use your phone’s camera to scan barcodes and request harmful substance information.

You don’t have a barcode? Then the product name is enough.

Get information from our database

Get harmful substance information immediately if the product is in our database so that you can avoid products with SVHCs. The database is still in its early stages. Use your ‘right to know’ and send requests to companies, then they will fill the database!

Create your own request!

The free-of-charge app for checking substances of very high concern (SVHCs) in products like clothing, sports equipment, toys etc.

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If information is not yet available in our database, you can send an automatic request via the app to the producer or retailer. The more requests they get, the more likely they will be to enter their product information in our database: Scan4Chem will get smarter – for the benefit of all consumers.

Life Ask REACH, 14 February 2020

<https://www.askreach.eu/app/>

71 substances added to Netherlands RIVM List of Substances of Very High Concern (ZZS)

2020-01-24

On 24 January 2020, the Netherlands' National Institute for Public Health and the Environment (RIVM) added 71 substances to the List of Substances of Very High Concern (ZZS).

Yodas Hive, 12 February 2020

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

Germany AwSV List of published WGK classifications updated

2020-02-17

On 17 February 2020, the German Ordinance on Facilities Handling Substances That Are Hazardous to Water (AwSV) List of published water hazard class (WGK) classifications was updated. The following substances were newly assigned a WGK:

1. Ammonium 2-amino-4-(hydroxymethylphosphinyl)butyrate
WGK 3 (highly hazardous to water)
2. 2-anilino-4,6-dimethylpyrimidine
WGK 2 (obviously hazardous to water)
3. Boric acid, zinc salt
WGK 3 (highly hazardous to water)
4. 1,3 butadiene/styrene copolymers
WGK 1 (slightly hazardous to water)
5. Carbamic acid, [(1S)-2-methyl-1-[[[1-(4-methylphenyl)ethyl]amino]carbonyl]propyl]-, 1-methylethyl ester
WGK 1 (slightly hazardous to water)

On 24 January 2020, the Netherlands' National Institute for Public Health and the Environment (RIVM) added 71 substances to the List of Substances of Very High Concern (ZZS).

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6. Chlorotrimethylsilane
WGK 1 (slightly hazardous to water)
7. Copper, grain size 0.074 - 1.0 mm
WGK 2 (obviously hazardous to water)
8. 1,1,1,2,2,3,4,5,5,5-Decafluoro-3-methoxy-4-(trifluoromethyl)pentane
WGK 1 (slightly hazardous to water)
9. Ethylene bis(3-mercaptopropionate)
WGK 3 (highly hazardous to water)
10. 1-N-[4-(heptafluoropropan-2-yl)-2-methylphenyl]-3-iodo-2-N-(1-methanesulfonyl-2-methylpropan-2-yl)benzene-1,2-dicarboxamide
WGK nwg (non-hazardous to water)
11. Hexaboron dizinc undecaoxide
WGK 3 (highly hazardous to water)
12. Isotridecyl mercaptoacetate
WGK 3 (highly hazardous to water)
13. 2-[[3-(3-mercapto-1-oxopropoxy)-2,2-bis[(3-mercapto-1-oxopropoxy)methyl]propoxy]methyl]-2-[(3-mercapto-1-oxopropoxy)methyl]propane-1,3-diyl bis[3-mercaptopropionate]
WGK 3 (highly hazardous to water)
14. Octadecyl 3-mercaptopropionate
WGK 1 (slightly hazardous to water)
15. Phenylephrine hydrochloride
WGK 1 (slightly hazardous to water)
16. Phosphoric acid, C14-15 branched and linear alkyl esters, potassium salts
WGK 1 (slightly hazardous to water)
17. Poly(oxy-1,2-ethanediyl),alpha-sulfo-omega-hydroxy-, C16-18 alkyl ethers, ammonium salts (6 EO)
WGK 2 (obviously hazardous to water)
18. Propanoic acid, 3-mercapto-, 1,1'-[2-[[2,2-bis[(3-mercapto-1-oxopropoxy)methyl]butoxy]methyl]-2-ethyl-1,3-propanediyl] ester
WGK 3 (highly hazardous to water)
19. Tetradecyloxirane
WGK 2 (obviously hazardous to water)

Yordas Hive, 20 February 2020

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

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Nordic Working Paper Per- and polyfluoroalkylether substances: identity, production and use

2020-02-20

The per- and polyfluoroalkyl substances (PFASs) are a class of chemicals of great concern today, due to their extreme persistence. The long-chain PFASs such as PFOS and PFOA (both perfluoroalkyl acids, or PFAAs) are known to be also bioaccumulative and toxic. Efforts have been made to phase out production and use of PFOS and PFOA in Europe and North America, and both PFOS and PFOA, together with their precursors, are now regulated globally under the Stockholm Convention. However, the chemical industry has developed many other PFASs, production of which continues. To date, some 4700+ monomeric and polymeric PFASs are identified as been on the global market, including many other than long-chain PFAAs and their precursors. This study focuses on one subset of PFASs, namely per- and polyfluoroalkylether substances (PFAEs). Many PFAEs are structurally similar to the rather well studied perfluoroalkyl acids (PFAAs) and their precursors, but with ether-linkage(s) between the perfluorocarbon moieties (e.g. $-C_nF_{2n}-O-C_mF_{2m}-$). A critical review found that due to structural similarities, many PFAEs have similar hazardous properties as PFAAs and their precursors¹. For example, perfluoroalkylether carboxylic acids (PFECAs) such as ADONA and GenX are similarly extremely persistent as PFOA, have high mobility in the environment, and can cause various toxicological adverse effects such as liver toxicity. Several PFECAs such as GenX and F-DIOX have been self-classified by their producers as "toxic" under REACH. Some current major producers of PFAAs and their precursors have also been the major producers of PFAEs since the 1970s². In recent years, some of them have additionally marketed novel PFAEs as replacements to PFAAs and their precursors³. However, in contrast to the well-studied PFAAs and their precursors, no clear overview of the production, import and use of all PFAEs is currently available in the public domain. While recent studies have focused on the two PFECAS RNw used as replacements to PFOA in fluoropolymer production, i.e. ADONA and GenX, many other PFAEs are being produced and used in a wide range of industrial and commercial applications without scrutiny. This lack of overview seriously hinders the efforts to understand, assess and manage these chemicals.

The per- and polyfluoroalkyl substances (PFASs) are a class of chemicals of great concern today, due to their extreme persistence.

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The full report can be accessed [here](#).

Report prepared by Dr. Zhanyun Wang, Gretta Goldenman, Tugce Tugran, Alicia McNeil and Matthew Jones (Milieu Consulting) for Nordic Working Group on Chemicals, Environment and Health, January 2020

<http://norden.diva-portal.org/smash/get/diva2:1392167/FULLTEXT02.pdf>

Adopted EU classification: titanium dioxide producers mull legal action

Amendments to CLP published in Official Journal

2020-02-18

Some titanium dioxide manufacturers have said they may explore legal action following publication of the European Commission's decision to classify the substance as a category 2 carcinogen by inhalation.

The entry in the EU's Official Journal on 18 February draws a line under an almost decade-long and highly contested regulatory measure.

No changes were made since its adoption on 4 October. It will enter into force after 20 days, with harmonised classifications applying from 9 September 2021.

The Regulation had a bumpy journey through the legislature amid warnings from industry that, because there is no direct substitute for titanium dioxide, the verdict could have a "catastrophic" impact on many industries, with knock-on effects for recycling. They disputed carcinogenicity based on the dust hazard, which they said is not specific to titanium dioxide.

The substance commands a huge market globally. Its pigment form, unique for its whiteness, high opacity, brightness and durability of colour, is mixed into paints, coatings and plastics. Other applications include cosmetics, food, textiles, rubber and pharmaceuticals.

The new requirement for titanium dioxide products to carry cancer warnings on the label will apply only to mixtures in powder form containing 1% or more of the substance with aerodynamic diameter of 10µm or less.

For other forms and mixtures, the classification suggests specific notes to inform the users of the precautionary measures that need to be taken to minimise hazard.

The entry in the EU's Official Journal on 18 February draws a line under an almost decade-long and highly contested regulatory measure.

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Consequences

The Titanium Dioxide Manufacturers Association (TDMA) said its members were looking “at the available options”, including taking legal action against the EU executive.

But for now, industry would prioritise implementation because it is “likely to enter into force before any legal proceeding could come to conclusion”, it said.

Even though the classification is only for the powder form, health warnings on many products that cannot be inhaled, like liquids and mixtures, are likely to increase consumers’ perception of risk and therefore influence the demand for them, the TDMA said. Other likely consequences include:

many paints no longer being available;

twice as much paint used to achieve comparable opacity;

building rubble, plaster and wallpaper containing titanium dioxide become hazardous waste; and

eco labels cease to apply to many consumer products.

Other poorly soluble low toxicity particles (PSLT) could also be implicated by the classification and “as a result, specific restrictions of several products may be triggered down the line,” the TDMA added.

To ensure consistency in implementation, the labelling requirements for liquids and mixtures should be clarified, it stressed. Industry also needs a clear interpretation of the implication for waste disposal, especially for the construction sector.

The European Council of the Paint, Printing Ink and Artists’ Colours Industry (Cepe) said it “regrets” the decision, also calling upon the Commission to establish clarity on the waste regulation “well before the entry into force. Any confusion about the applicability must be avoided to ensure a level playing field across Europe,” it said.

And Martin Kanert, director general of the German Paint and Printing Ink Association (VdL), said it would have to negotiate with those responsible for the award criteria for eco labels because these normally ban the presence of carcinogenic, mutagenic and reprotoxic (CMR) substances.

The same holds true for products with applications in toys, he added.

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VdL, together with another trade body representing titanium dioxide manufacturers in Germany, will launch a dedicated website Forum Titandioxid in March to provide information on the safety of paints and printing inks in terms of the classification.

The delegated Regulation forms the 14th adaptation to technical progress (ATP) of the CLP Regulation, which contains amendments for 28 substances, including a carcinogen classification for cobalt metal.

Chemical Watch, 18 February 2020

<https://chemicalwatch.com/94434/european-commission-publishes-titanium-dioxide-classification>

<https://chemicalwatch.com/94434/european-commission-publishes-titanium-dioxide-classification>

INTERNATIONAL

Release of eChemPortal v3.0

2020-02-03

03 February 2020

The OECD is pleased to announce the release of eChemPortal v3.0. This new version includes a modernisation of the user interface architecture, a refreshed design, improved navigation and the alignment of eChemPortal to OECD Harmonised Template (OHT) 2018. The user experience is now more fluid and the user can search for chemical information more efficiently. New features include quick search functionality from the homepage, filtering and sorting on results tables, and a preliminary indication of the number of results expected in a search by chemical properties. The searches also have been harmonised to increase intuitivity for the user.

OECD, 3 February 2020

<https://www.echemportal.org/echemportal/content/news>

The user experience is now more fluid and the user can search for chemical information more efficiently

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Towards circular economy: test our database to track harmful chemicals in products

20200217

Companies can now start to test ECHA's SCIP database of products containing Candidate List substances of very high concern. The final database will be launched later this year.

Companies will need to submit information to it from January 2021 onwards.

ECHA, 17 February 2020

<https://echa.europa.eu/>

Working towards one global IUCLID

2020-02-13

Over the past decade, a considerable amount of information on chemicals available on the EU market has been submitted by companies to ECHA. The data is used to assess the safety of the chemicals and to find appropriate ways to manage their risks. Most of it has also been published on ECHA's website, but there are plans to make the data and our knowledge around it available for even broader use in the future.

The data has been collected in a tool called IUCLID which allows users to record, store, submit and exchange data on chemicals in an internationally agreed format. IUCLID has become essential for anyone managing scientific data on chemicals in a regulatory context.

The information collected through REACH registrations, classification and labelling notifications and biocide applications, to mention some, forms the largest regulatory database on chemicals in the world.

You can read the full Article [here](#)

ECHA Newsletter, 13 February 2020

<https://newsletter.echa.europa.eu/home/-/newsletter/entry/working-towards-one-global-iuclid>

Users of NMP – how to comply with the restriction

2020-02-13

From 9 May 2020, *1-methyl-2-pyrrolidone*, also known as *NMP*, must not be placed on the EU market, nor used, on its own or in mixtures, unless

Companies can now start to test ECHA's SCIP database of products containing Candidate List substances of very high concern.

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certain conditions are met. The substance is widely used as a solvent, for example in the petrochemical, surface treatment and pharmaceutical industries. ECHA Newsletter explains what this restriction means for companies.

What is NMP?

NMP is used in high volumes as a solvent and a medium for surface deposition when producing batteries, semiconductors, fibres, pharmaceuticals and wire coatings. The chemical has a harmonised classification indicating that it may cause damage to the unborn child, serious eye and skin irritation and respiratory irritation.

Due to its reproductive toxicity and high volumes, the European Commission added the substance to the [REACH restriction list](#) in April 2018. The restriction enters into force in May 2020 bringing in strict limitations for its use. But there is an exception for NMP uses in wire coatings, where the restriction will apply from 9 May 2024.

Strict conditions for its use

The restriction does not mean that NMP can no longer be used on the EU market but it places strict conditions on its use.

If the substance is produced or used in concentrations of 0.3 % or more, manufacturers, importers and downstream users must put appropriate risk management measures and operational conditions in place to protect their workers from any exposure.

This should be done by using the agreed derived no-effect levels (DNELs) in the relevant chemical safety reports and safety data sheets. The DNELs refer to a level of exposure to a substance below which no negative health effects are expected. For NMP, the levels for worker exposure are 14.4 mg/m³ if inhaled and 4.8 mg/kg/day if skin is exposed. Having the DNELs as part of the restriction make the levels binding across the EU.

A manufacturer's perspective

The NMP restriction affects the whole supply chain from the substance manufacturer to downstream users, who can vary from knowledgeable chemical companies to industrial users operating outside of the chemical industry.

According to *Jens-Olaf Eichler-Haeske*, Global Product Stewardship Manager at [BASF SE](#), their company is already implementing high occupational safety and process safety standards to protect their workers

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from the exposure to NMP. "BASF SE and other NMP manufacturers have already put in place strictly controlled manufacturing conditions which mean that we, in practice, already comply with the restriction," he explains.

Since it is the manufacturers' role under REACH to evaluate the use of a substance and to advise on safe use conditions, BASF SE communicates the information needed to comply with the restriction to their customers as part of extended safety data sheets (eSDSs). "Often, the problem is that downstream users outside the chemical industry may not know how to read the exposure scenarios and the information on safe use found in the eSDSs. They may face difficulties in extracting the information and translating it into real risk management measures," Dr Eichler-Haeske points out.

This is where ECHA's NMP guideline can help by providing answers and examples. "An NMP downstream user should start by identifying the exposure scenario that fits to the use. For translating the advice given in the eSDSs, take a look in the annex to the guideline, which provides pictures of safe use for some standard uses of NMP. By following the instructions of the eSDSs correctly, you can make sure that you use NMP under safe conditions and in compliance with the restriction," Dr Eichler-Haeske says.

Exemption for the wire coating sector

The wire winding sector is highly dependent on NMP as the enamel they use when coating wires to form protective electrical insulation, normally contains NMP.

"The restriction has clearly increased awareness about the consequences that using NMP-containing enamels has on our industry," says *Andreas Levermann*, Managing Director of SHWire.

The restriction for the wire winding sector enters into force in May 2024, but it has already been discussed in depth by the industry association. Many of the companies using enamels that contain NMP are already working hard to ensure workers' safety, but they may still need to look into their risk management measures to ensure they fully comply with the restriction.

"Each company has a series of choices to make related to exhaust ventilation, limitations for possible exposure times, and suitable respiratory equipment to mention some," Dr Levermann explains.

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As the amount of NMP in an enamel depends on the wire properties, the restriction will not have a big impact on the material and the solvent itself. Preparations are still needed before the restriction starts to apply. "The most significant impact concerned the use of new types of better-controlled ovens and enamelling machines, which led companies to modernise their machines, which, of course, required high levels of investment," Dr Levermann adds.

The ECHA guideline has given useful advice and support for the wire winding sector. "You should not only pay attention to the technical part of the guideline. Also the introductory chapters that explain, for example, the limits and DNELs can help you understand what impact the restriction has on our everyday work," Dr Levermann concludes.

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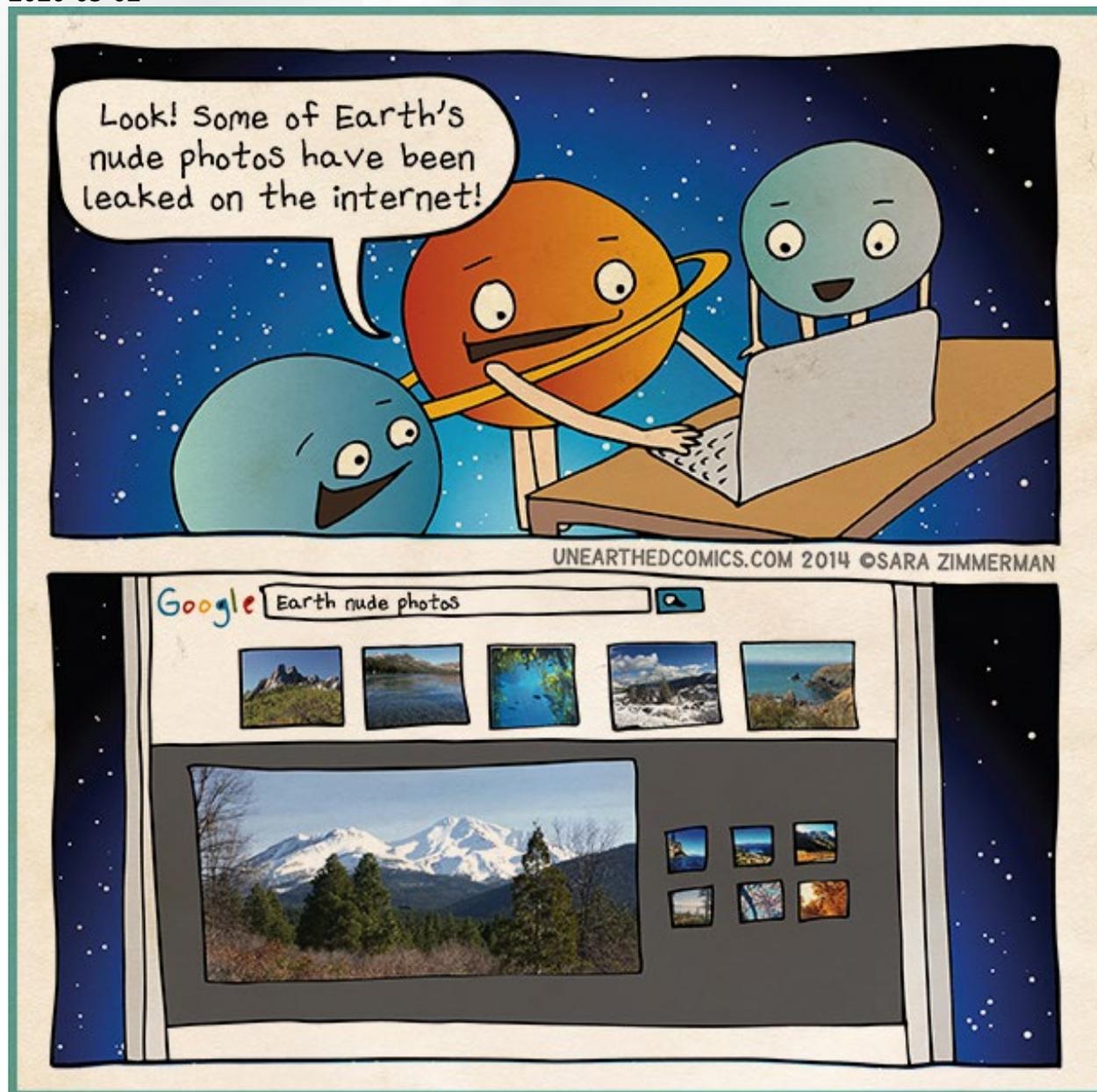
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Janet's Corner

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Earth's Nudes

2020-03-02



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Hazard Alert

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Arsenic

2020-02-02

Arsenic is a chemical element with the symbol As, an atomic mass of 74.921 595, and an atomic number of 33. It is in the pnictogens group of the periodic table and its element category is Metalloid. Arsenic has a metallic grey appearance and is primarily used in alloys of lead. Its multiple allotropes come in a variety of colours—including yellow and black—but only the grey form is important to industry. Arsenic is found in many minerals, usually in combination with metals and sulfur, but it can also present as a pure elemental crystal. Arsenic is both an organic and inorganic chemical. It is a Group-A carcinogen and all forms of the element are a serious risk to human health. [1, 2]

USES [1,2]

Arsenic is primarily used for strengthening alloys of lead and copper for use in car batteries or ammunition. While once a popular component in the production of pesticides, herbicides and insecticides, the use of arsenic is declining due to toxicity of the chemical. Arsenic is also used as an n-type dopant in semi conductive electronic devices. Some species of bacteria use arsenic compounds as respiratory metabolites, and trace elements of the chemical are essential in the diets of rats, hamsters, goats and chickens. There is no known role for arsenic in human metabolism—however, arsenic contamination of groundwater affects millions of people across the globe.

ROUTES OF EXPOSURE [3]

- People can be exposed to arsenic by skin contact, inhaling it, or by consuming contaminated food, water or other drinks.
- Humans are normally exposed to trace amounts of arsenic in the air, water and foods they consume.
- Higher levels of arsenic may be found in industrial areas that currently or previously contained arsenic.
- Drinking water that is associated with high levels of arsenic is known as an area of high exposure.

Arsenic is a chemical element with the symbol As, an atomic mass of 74.921 595, and an atomic number of 33.

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HEALTH EFFECTS

Arsenic poisoning can be a result of organic or inorganic arsenic, and it affects a range of systems including the skin, nervous, respiratory and cardiovascular systems.

Acute Effects [4]

Severity of symptoms depend on the level and type of exposure. Acute effects are the result of short-term exposure by high concentrations of arsenic.

- If the arsenic is inhaled, pulmonary oedema, dyspnoea and mucous membrane irritation may occur.
- If swallowed, arsenic can cause severe vomiting and abdominal pain within the first one to two hours.
- Cardiovascular effects include vasodilation, cardiac depression and cardiac shock.
- Symptoms of CNS and PNS effects include: headache, coma, convulsions, cerebral oedema and/or sensory loss.
- Arsenic poisoning can also result in anaemic, leukopaenia and hepatic toxicity.

Chronic Effects [4]

Arsenic is toxic to multiple body systems. Long-term exposure to the element can cause skin changes (new lesions, redness, swelling, darkening or discolouration and hyperkeratosis—bumps in the skin that resemble warts), and persistent digestive issues, including problems with liver and kidney function. It has also been linked to causing conjunctivitis, loss of appetite, weakness, motor paralysis and bone marrow depression with pancytopenia. Chronic arsenic exposure has been linked to the development of certain cancers, including that of the kidney, lung, skin and bladder. Long-term symptoms can be present 5 years after exposure. Inorganic arsenic compounds are more toxic than its organic counterparts.

SAFETY

First Aid Measures [5]

- Ingestion: If ingested, rinse mouth and DO NOT induce vomiting. Arsenic is fatal if swallowed. Immediately call a doctor or a poison centre.

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- **Skin contact:** In case of skin or hair contact, remove/take off all contaminated clothing immediately and thoroughly rinse with water. Immediately call a doctor or poison centre.
- **Eye contact:** Flush eyes carefully with water for several minutes. Check for and remove contact lenses if easy to do so. Continue rinsing.
- **Inhaled:** Take contaminated person to nearest fresh air source and monitor their breathing.
- **General:** Never administer anything by mouth to an unconscious, exposed person.

Exposure Controls/Personal Protection [5]

- **Engineering controls:** Safety showers and emergency eyewash fountains should be accessible in the immediate area of the potential exposure. Ensure there is adequate ventilation. Whenever possible, material should be handled in a laboratory.
- **Personal protection:** Safety glasses, protective and dustproof clothing, gloves and a combined gas/dust mask with a B/P3 filter.

REGULATION [6]

United States:

Agency	Level
ACGIH (American Conference of Governmental Industrial Hygienists)	10 micrograms/m ³
NIOSH (National Institute for Occupational Safety and Health)	2 micrograms/m ³
OSHA (Occupational Safety and Health Administration)	10 micrograms/m ³
EPA (Environmental Protection Agency)	10 parts per billion
FDA (Food and Drug Administration)	0.5-2 parts per million

Australia [4]

Safe Work Australia: Safe Work Australia has set an 8-hour time weighted average (TWA) concentration for arsenic of 0.05mg/m³. However, it should be noted that the TWA values are likely to be higher than the biological standards exposure level for the chemical; therefore, all reasonable steps must be taken to minimise the level of exposure to a level well below the workplace standard.

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From 'living' cement to medicine-delivering biofilms, biologists remake the material world

2020-02-18

The bricks in Wil Srubar's lab at the University of Colorado, Boulder, aren't just alive, they're reproducing. They are churned out by bacteria that convert sand, nutrients, and other feedstocks into a form of biocement, much the way corals synthesize reefs. Split one brick, and in a matter of hours you will have two. Engineered living materials (ELM) are designed to blur boundaries. They use cells, mostly microbes, to build inert structural materials such as hardened cement or woodlike replacements for everything from construction materials to furniture. Some, like Srubar's bricks, even incorporate living cells into the final mix. The result is materials with striking new capabilities, as the innovations on view last week at the Living Materials 2020 conference in Saarbrücken, Germany, showed: airport runways that build themselves and living bandages that grow within the body. "Cells are amazing fabrication plants," says Neel Joshi, an ELM expert at Northeastern University. "We're trying to use them to construct things we want." Humanity has long harvested chemicals from microbes, such as alcohol and medicines. But ELM researchers are enlisting microbes to build things. Take bricks, normally made from clay, sand, lime, and water, which are mixed, molded, and fired to over 1000°C. That takes lots of energy and generates hundreds of millions of tons of carbon emissions annually. A Raleigh, North Carolina, company called bioMASON was among the first to explore using bacteria instead of heat, relying on the microbes to convert nutrients into calcium carbonate, which hardens sand into a sturdy construction material at room temperature. Now, several groups are taking the idea further. "Could you grow a temporary runway somewhere by seeding bacteria in sand and gelatin?" asks Sarah Glaven, a microbiologist and ELM expert at the U.S. Naval Research Laboratory. In June 2019, researchers at Wright-Patterson Air Force Base in Ohio did just that to create a 232-square-meter runway prototype. The hope, says Blake Bextine, who runs an ELM program for the U.S. Defense Advanced Research Projects Agency, is that rather than ferrying tons of materials to set up expeditionary air fields, military engineers could use local sand, gravel, and water, and apply a few drums of cementmaking bacteria to create new runways in days. The bricks and runway cement don't retain living cells in the final structure. But Srubar's team is taking that next step. In their self-reproducing bricks, researchers mix a nutrient-based gel with sand and inoculate it with bacteria that form calcium carbonate. They then control the temperature and humidity to keep the bacteria viable. The researchers could split their original brick in half, add extra sand,

Split one brick, and in a matter of hours you will have two

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hydrogel, and nutrients, and watch as bacteria grew two full-size bricks in 6 hours. After three generations, they wound up with eight bricks, they reported in the 15 January issue of *Matter*. (Once the bacteria are done growing new bricks, the team can turn off the temperature and humidity controls.) Srubar calls it “exponential material manufacturing.” ELM makers are also harnessing microbes to make biomaterials for use in the human body. Microbes naturally exude proteins that bind to one another to form a physical scaffold. More bacteria can adhere to it, forming communal microbial mats known as biofilms, found on surfaces from teeth to ship hulls. Joshi’s team is developing biofilms that could protect the gut lining, which erodes in people with inflammatory bowel disease, creating painful ulcers. In the 6 December 2019 issue of *Nature Communications*, they reported that an engineered *Escherichia coli* in the guts of mice produced proteins that formed a protective matrix, which shielded the tissue from chemicals that normally induce ulcers. If the approach works in people, physicians could inoculate patients with an engineered form of a microbe that normally makes its home in the gut. In another medical use, bacteria could turn conventional materials into drug factories. In the 2 December 2019 issue of *Nature Chemical Biology*, for example, Christopher Voigt of the Massachusetts Institute of Technology and his colleagues describe seeding a plastic with bacterial spores that continuously generate bacteria. The microbes synthesize an antibacterial compound effective against *Staphylococcus aureus*, a dangerous infectious bacterium. A team of researchers led by Chao Zhong of ShanghaiTech University engineered biofilms for a different purpose: detoxifying the environment. They started with the bacterium *Bacillus subtilis*, which secretes a matrix-forming protein called TasA. Other researchers had shown that TasA was easy to genetically engineer to bind to other proteins. The team tweaked TasA to get it to bind an enzyme that degrades a toxic industrial compound called mono (2-hydroxyethyl terephthalic acid), or MHET. They then showed that biofilms created by the engineered bacterium could break down MHET—and that biofilms made by a mix of two engineered strains of *B. subtilis* could carry out a two-step degradation of an organophosphate pesticide called paraoxon. The results, which the team reported in the January 2019 issue of *Nature Chemical Biology*, raise the prospect of living walls that purify the air. Regulatory issues could slow progress, however. Many of the bacteria that ELM researchers have harnessed occur in nature and should not trigger regulatory scrutiny. But genetically engineered organisms will—and the prospect of engineered microbes embedded in, say, living

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walls might unsettle regulators. Still, Voigt predicts, "I think in 10 years, we're going to find living cells in a whole range of living products."

sciencemag.org, 18 February 2020

<https://www.sciencemag.org>

Minke whales are struggling to communicate over the din of ocean noise

2020-02-18

Imagine a frog call, but with a metallic twang—and the intensity of a chainsaw. That's the "boing" of a minke whale. And it's a form of animal communication in danger of being drowned out by ocean noise, new research shows. By analyzing more than 42,000 minke whale boings, scientists have found that, as background noise intensifies, the whales are losing their ability to communicate over long distances. This could limit their ability to find mates and engage in important social contact with other whales. Tyler Helble, a marine acoustician at the Naval Information Warfare Center Pacific, and colleagues recorded minke whale boings over a 1200-square-kilometer swath of the U.S. Navy's Pacific Missile Range Facility near the Hawaiian island of Kauai from 2012 to 2017. By measuring when a single boing arrived at various underwater microphones, the team pinpointed whale locations to within 10 to 20 meters. The researchers then used these positions, along with models of how sound propagates underwater, to calculate the intensity of each boing when it was emitted. The team compared these measurements with natural ambient noise, including waves, wind, and undersea earthquakes. (No military exercises were conducted nearby during the study period.) They found that minke whale boings grew louder in louder conditions. That's not surprising—creatures across the animal kingdom up their volume when there's background noise. (This phenomenon, dubbed the Lombard effect, holds true for humans, too—think of holding a conversation at a loud concert.) But minke whales' responses differ from those of other whales, the team found. Orcas and humpbacks seem to compensate fully for increasing noise—the intensity of their calls grows in lockstep with ambient noise levels. The calls of minke whales, on the other hand, increased only marginally in the presence of loud noise. That's similar to the responses of bottlenose dolphins and even some terrestrial animals, such as bats and frogs. The minke's relatively quieter calls mean that population estimates of the small, elusive whales—typically conducted using acoustic surveys—are probably inaccurate, the researchers suggest. The animals aren't endangered, but very little is known about them, says team member

By analyzing more than 42,000 minke whale boings, scientists have found that, as background noise intensifies, the whales are losing their ability to communicate over long distances

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Regina Guazzo, a marine ecologist at the Naval Information Warfare Center Pacific. "Sound is the primary way whales sense and understand their environment." Helble and his colleagues estimate that minke whales calling in a relatively low-noise environment could be heard by others as far as 114 kilometers away; as noise levels increased, that range dropped to just 19 kilometers, they report this month in *The Journal of the Acoustical Society of America*. "It's an order of magnitude change in communication range," Guazzo says. "[Because] it's hard to know how far they need to be able to communicate, this could have a really negative impact." The researchers say humanmade noise—caused by shipping activity or military exercises, for example—would likely have the same effect as natural noise. That's significant, as the ocean has been getting louder by roughly 3 decibels per decade, primarily because of commercial shipping. As prolific noisemakers, we have an obligation to limit the potentially harmful sounds permeating the ocean, says Cornell University marine ecologist Michelle Fournet, who was not involved in the work. "If we start to understand where the inability to communicate kicks in, we can change our human behavior."

sciencemag.org, 18 February 2020

<https://www.sciencemag.org>

Think all BPA-free products are safe? Not so fast, scientists warn
2020-02-18

Using "BPA-free" plastic products could be as harmful to human health -- including a developing brain -- as those products that contain the controversial chemical, suggest scientists in a new study led by the University of Missouri and published in the *Proceedings of the National Academy of Sciences*. For decades, scientists have studied BPA extensively in animal models with results indicating the chemical plays a role in early pregnancy loss, placental diseases and various negative health outcomes after birth. As these adverse health effects have become more widely known, companies have turned to using alternative chemicals to develop plastic products—namely water bottles and food containers—and often labeling them "BPA-free." However, MU scientist Cheryl Rosenfeld warns these chemical alternatives, such as bisphenol S (BPS), still aren't safe for people to use. In the study, Rosenfeld and her colleagues focused on examining the effects of BPS on a mouse's placenta. She said the placenta serves as a historical record of what an unborn child faces while in the womb; the placenta also can transfer whatever the mother might be exposed to in her blood, such as harmful chemicals, into the developing

As these adverse health effects have become more widely known, companies have turned to using alternative chemicals to develop plastic products—namely water bottles and food containers—and often labeling them "BPA-free."

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child. "Synthetic chemicals like BPS can penetrate through the maternal placenta, so whatever is circulating in the mother's blood can easily be transferred to the developing child," said Rosenfeld, a professor of biomedical sciences in the College of Veterinary Medicine, investigator in the Bond Life Sciences Center, and research faculty member for the Thompson Center for Autism and Neurobehavioral Disorders at MU. "This mouse model is the best model we have now to simulate the possible effects of BPS during human pregnancy, because the placenta has a similar structure in both mice and humans." Rosenfeld adds that the placenta serves as a primary source of serotonin for fetal brain development in both mice and humans. Serotonin, while commonly associated with the feeling of happiness, is a natural chemical that can impact a person's functions, including their emotions and physical activities such as sleeping, eating and digesting food. "The placenta responds to both natural chemicals as well as synthetic chemicals that the body misinterprets as natural chemicals, but the body doesn't have the ability to mitigate the detrimental effects of such industrial-made chemicals," Rosenfeld said. "More importantly, these chemicals have the ability to lower the placenta's serotonin production. Lower levels of serotonin can compromise fetal brain development because during this critical time in development the brain relies on the placenta to produce serotonin. Thus, developmental exposure to BPA or even its substitute, BPS, can lead to longstanding health consequences." Rosenfeld's research is an example of an early step in translational medicine, or research that aims to improve human health by determining the relevance of animal science discoveries to people. This research can provide the foundation for precision medicine, or personalized human health care. Precision medicine will be a key component of the NextGen Precision Health Initiative -- the University of Missouri System's top priority -- by helping to accelerate medical breakthroughs for both patients in Missouri and beyond.

sciencedaily.com, 18 February 2020

<https://www.sciencedaily.com>

Beta-arrestin-2 increases neurotoxic tau driving frontotemporal dementia

2020-02-18

The protein β -arrestin-2 increases the accumulation of neurotoxic tau tangles, a cause several forms of dementia, by interfering with removal of excess tau from the brain, a new study by the University of South Florida Health (USF Health) Morsani College of Medicine found. The USF

The USF Health researchers discovered that a form of the protein comprised of multiple β -arrestin-2 molecules, known as oligomerized β -arrestin-2, disrupts the protective clearance process normally ridding cells of malformed proteins like disease-causing tau.

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Health researchers discovered that a form of the protein comprised of multiple β -arrestin-2 molecules, known as oligomerized β -arrestin-2, disrupts the protective clearance process normally ridding cells of malformed proteins like disease-causing tau. Monomeric β -arrestin-2, the protein's single-molecule form, does not impair this cellular toxic waste disposal process known as autophagy. Their findings were published today in the *Proceedings of the National Academy of Sciences (PNAS)*. The study focused on frontotemporal lobar degeneration (FTLD), also called frontotemporal dementia -- second only to Alzheimer's disease as the leading cause of dementia. This aggressive, typically earlier onset dementia (ages 45-65) is characterized by atrophy of the front or side regions of the brain, or both. Like Alzheimer's disease, FTLD displays an accumulation of tau, and has no specific treatment or cure. "Our research could lead to a new strategy to block tau pathology in FTLD, Alzheimer's disease and other related dementias, which ultimately destroys cognitive abilities such as reasoning, behavior, language, and memory," said the paper's lead author JungA (Alexa) Woo, PhD, an assistant professor of molecular pharmacology and physiology and an investigator at the USF Health Byrd Alzheimer's Center. "It has always been puzzling why the brain cannot clear accumulating tau" said Stephen B. Liggett, MD, senior author and professor of medicine and medical engineering at the USF Health Morsani College of Medicine. "It appears that an 'incidental interaction' between β -arrestin-2 and the tau clearance mechanism occurs, leading to these dementias. β -arrestin-2 itself is not harmful, but this unanticipated interplay appears to be the basis for this mystery." "This study identifies beta-arrestin-2 as a key culprit in the progressive accumulation of tau in brains of dementia patients," said coauthor David Kang, PhD, professor of molecular medicine and director of basic research for the Byrd Alzheimer's Center. "It also clearly illustrates an innovative proof-of-concept strategy to therapeutically reduce pathological tau by specifically targeting beta-arrestin oligomerization." The two primary hallmarks of Alzheimer's disease are clumps of sticky amyloid-beta ($A\beta$) protein fragments known as amyloid plaques and neuron-choking tangles of a protein called tau. Abnormal accumulations of both proteins are needed to drive the death of brain cells, or neurons, in Alzheimer's, although the tau accumulations now appear to correlate better with cognitive dysfunction than $A\beta$, and drugs targeting $A\beta$ have been disappointing as a treatment. $A\beta$ aggregation is absent in the FTLD brain, where the key feature of neurodegeneration appears to be excessive tau accumulation, known as tauopathy. The resulting neurofibrillary tangles -- twisted fibers laden with tau -- destroy synaptic communication between neurons, eventually killing the brain cells. "Studying FTLD gave us that window to

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study a key feature of both types of dementias, without the confusion of any A β component," Dr. Woo said. Monomeric β -arrestin-2 is mostly known for its ability to regulate receptors, molecules on the cell that are responsible for hormone and neurotransmitter signaling. β -arrestin-2 can also form multiple interconnecting units, called oligomers. The function of β -arrestin-2 oligomers is not well understood. The monomeric form was the basis for the laboratory's initial studies examining tau and its relationship with neurotransmission and receptors, "but we soon became transfixed on these oligomers of β -arrestin-2," Dr Woo said. Among the researchers' findings reported in *PNAS*:

- Both in cells and in mice with elevated tau, β -arrestin-2 levels are increased. Furthermore, when β -arrestin-2 is overexpressed, tau levels increase, suggesting a maladaptive feedback cycle that exacerbates disease-causing tau.
- Genetically reducing β -arrestin-2 lessens tauopathy, synaptic dysfunction, and the loss of nerve cells and their connections in the brain. For this experiment researchers crossed a mouse model of early tauopathy with genetically modified mice in which the β -arrestin-2 gene was inactivated, or knocked out.
- Oligomerized β -arrestin-2 -- but not the protein's monomeric form - increases tau. The researchers blocked β -arrestin-2 molecules from binding together to create oligomerized forms of the protein. They demonstrated that pathogenic tau significantly decreased when only oligomeric β -arrestin-2, which does bind to receptors, was present.
- Oligomerized β -arrestin-2 increases tau by impeding the ability of cargo protein p62 to help selectively degrade excess tau in the brain. In essence, this reduces the efficiency of the autophagy process needed to clear toxic tau, so tau "clogs up" the neurons.
- Blocking of β -arrestin-2 oligomerization suppresses disease-causing tau in a mouse model that develops human tauopathy with signs of dementia.

"We also noted that decreasing β -arrestin-2 by gene therapy had no apparent side effects, but such a reduction was enough to open the tau clearance mechanism to full throttle, erasing the tau tangles like an eraser," Dr. Liggett said. "This is something the field has been looking for -- an intervention that does no harm and reverses the disease." "Based on our findings, the effects of inhibiting β -arrestin-2 oligomerization would be expected to not only inhibit the development of new tau tangles, but also to clear existing tau accumulations due to the mechanism of enhancing tau clearance," the paper's authors conclude. The work is consistent with

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a new treatment strategy that could be preventive for those at risk or with mild cognitive impairment, and also for those with overt dementias caused by tau, by decreasing the existing tau

tangles~seurekalert.org, 18 February 2020

<https://www.eurekalert.org>

Human body temperature has declined steadily over the past 160 years

2020-01-10

It's a number everybody knows by heart—our bodies are supposed to be an average 37°C. But that number may be outdated, according to a new analysis of body temperature records going back to 1860. The study suggests the body temperature of the average U.S. man has dropped by 0.6°C since the Civil War, *KQED* reports. (A similar drop was found in women.) Other studies had already established these newer, lower baselines, blaming faulty thermometers for the discrepancy. But the new research suggests the original number—established in the 1850s—was correct, and that body temperature has declined gradually ever since. That drop may be a product of lower overall levels of inflammation, thanks to antibiotics, vaccines, and improved water quality, the authors report this week in *eLife*. Modern technologies, such as central heating and air conditioning, could also help explain the trend.

sciencemag.org, 10 January 2020

<https://www.sciencemag.org>

Boron-nitrogen compound is close cousin of benzene

2020-02-16

A cunningly modified ring of boron and nitrogen atoms is the closest inorganic analog of benzene yet created, its creators say (*Angew. Chem., Int. Ed.* 2020, DOI: [10.1002/anie.201915790](https://doi.org/10.1002/anie.201915790)). The first inorganic version of benzene was reported almost a century ago. Borazine ($B_3N_3H_6$) contains a flat six-membered ring and a delocalized cloud of six π electrons but is only moderately aromatic. Since borazine's discovery, a handful of other inorganic benzenes have been created, none of which seem to have much aromaticity. Rei Kinjo and Kei Ota at Nanyang Technological University have now created a 1,4,2,3,5,6-diazatetraborinine derivative that is much more benzene-like than its predecessors. The blue solid is a valence isomer of benzene, with each ring atom bearing only one substituent.

The study suggests the body temperature of the average U.S. man has dropped by 0.6°C since the civil war, KQED reports

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Unlike borazine's alternating pattern of elements, diazatetaborinine's ring includes four boron atoms that sit in pairs and bond to either chlorine or trimethylphosphine. X-ray crystallography shows that the molecule is flat and has a perfectly hexagonal central ring, while nuclear magnetic resonance measurements demonstrate the magnetic deshielding effects typical of aromatic rings. The researchers' theoretical calculations show that the molecule's six π electrons are highly delocalized and that its aromaticity lies between that of benzene and borazine. "By modulating the position of inorganic elements, we have demonstrated that even inorganic benzenes can exhibit a pronounced aromatic nature," Kinjo says.

cen.acs.org, 16 February 2020

<https://www.cen.acs.org>

'Bees with backpacks' study crucial in fight to protect fresh food supply
2020-01-23

Australia's Honey Bee population has taken a blow over the past 12 months with drought and fires resulting in a 70 per-cent drop in honey production - but Macquarie researchers hope their innovative new project will help solve the crisis. Early calculations estimate that more than 50,000 hives around Australia have lost their bees in the extreme heat and recent bush fires, says biologist Professor Andrew Barron. This is thought to be a conservative estimate and one which will have long term effects on honey production and almond production as well as the regeneration of Australia's burnt bush. But Professor Barron is hoping microscopic tagging of individual bees will uncover crucial new data which could help the world's bee colonies survive and ultimately protect our fresh food supply.

Digital backpacks

Lead by Professor Barron, the team from the Department of Biological Sciences has been calculating the effects of heat and stress on bees by using tiny digital chips which are manually glued to the bees backs as they hatch from the hive. These chips monitor and record the bees entire working life. On average a bee will exit the hive around nine times a day to gather nectar and pollen for honey production. The research hives are electronically weighed every minute to monitor the growing honey stash delivered on the bees return. In the heat, some bees are redirected from their foraging to gather cooling water to splash through the hive while others turn their efforts to fanning the hive in order to maintain its precise healthy temperature of 34.5 degrees C. This information on the bees' working habits and the resulting yields of honey is critical in finding

The research hives are electronically weighed every minute to monitor the growing honey stash delivered on the bees return.

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ways to help them survive the effects of climate change. Barron says we can all contribute to the sustainability of the bee population by avoiding pesticides in the garden, and by growing flowering plants and vegetables to provide the pollen and nectar for healthy bee colonies to thrive.

Heat stress research

Data already collected has found that bees react to stress by becoming foragers when very young, but the immature bees perform terribly as foragers. Most of the young foragers complete just a handful of successful trips before dying. This intensifies the pressures on the colony, setting up conditions for catastrophic population decline. The data is now being used to construct a mathematical model of colony demographics which accurately captures the unusual features of a colony collapse. This research reveals for the first time the mechanism of a hive collapse. The researchers are now working on developing ways to address population decline and rescue failing colonies. The team is now pursuing field research in collaboration with the United States Department of Agriculture and CSIRO to test interventions to rescue colonies and develop new and cost-effective sensor strategies to give beekeepers an early warning that a colony is at risk while there is still time to intervene.

[lighthouse.mq.edu.au](https://www.lighthouse.mq.edu.au), 23 January 2020

<https://www.lighthouse.mq.edu.au>

Quantum internet closer as physicists stretch spooky link between atoms
2020-02-13

Physicists in China have forged a mysterious quantum connection between particles, called entanglement, over dozens of kilometers of standard optical fiber, setting a new record. The advance marks a long step toward a fully quantum mechanical internet—although such a network is still years away. The achievement springs not from one particular breakthrough, but from the careful implementation of multiple techniques, says David Awschalom, a physicist at the University of Chicago. "I'm very impressed that they've integrated these various technologies into a full system," he says. "It's a beautiful piece of work." Entanglement links the strange states of tiny quantum mechanical objects. For example, a top can spin either clockwise or counterclockwise, but an atom can spin both ways at once—at least until it is measured and that two-way state collapses one way or the other. Two atoms can be entangled so that each is in an uncertain two-way state, but their spins are definitely correlated, say, in opposite directions. So if physicists measure

Entanglement would be key to a fully quantum internet that would let quantum computers of the future communicate with one another and be immune to hacking.

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the first atom and find it spinning clockwise, they know instantly the other one must be spinning counterclockwise, no matter how far away it is. Entanglement would be key to a fully quantum internet that would let quantum computers of the future communicate with one another and be immune to hacking. If hackers messed with communication, they would spoil the entanglement, revealing their presence. Various companies already sell systems that send messages in quantum states of light that are largely unhackable. But to use such links, the information must still be decoded at each network node, which is potentially vulnerable. In a quantum internet, any node could be entangled with any other, so messages between them couldn't be decoded at intermediate nodes. But developers must first stretch entanglement over greater distances. Previously, researchers had demonstrated entanglement of two bits of matter over 1.3 kilometers of optical fiber. Now, Xiao-Hui Bao, Jian-Wei Pan, and colleagues at the University of Science and Technology of China, Beijing, have demonstrated entanglement over fiber optic links of up to 50 kilometers, as they report this week in *Nature*. The details are dizzying, but the basic idea of the experiment is relatively simple. Researchers start with two identical stations in a single lab, each containing a cloud of rubidium atoms. Prodding each cloud with a laser, they generate a photon whose polarization, which can corkscrew clockwise or counterclockwise, is entangled with the cloud's internal state. They then send the photons down two parallel optical fibers to a third station in another lab 11 kilometers away, where the photons interact in a way that instantly passes the original entanglement connection to the two faraway atom clouds. To do that, physicists take advantage of the fact that, according to quantum mechanics, a measurement can affect the state of the measured object. At the destination lab, the physicists set up a measurement of the photons' polarizations that, even as it consumes the photons, it also "projects" them into a specific entangled state with 25% probability. For those trials, the measurement instantly passes the entanglement back to the atom clouds. The researchers performed a variant of the experiment that extended the link from 22 kilometers to 50 kilometers, albeit with fibers wound on spools. To make the experiment work, the team had to get several elements just right, Pan says. A major hurdle was avoiding absorption of the photons in the optical fiber. To do that, Pan and colleagues used another laser pulse and a device called a waveguide to stretch the photons' wavelength 60% to the sweet spot for transmission down a standard optical fiber. At the same, the researchers made life easier for themselves because the atoms clouds were actually less than 1 meter apart and merely connected by a long optical fiber. That closeness made synchronizing the experiment significantly simpler.

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So, strictly speaking, the record of entangling atomic-scale particles separated by 1.3 kilometers still stands, says, Ronald Hanson, a physicist at Delft University of Technology, who led that earlier effort. Still, Hanson says, the experiment is significant because, for a network, the setup link is about half of the basic element called a quantum repeater. A repeater would consist of two systems like the one in the experiment placed end to end. Once physicists had entangled the atom clouds at the ends of each system, they could perform additional measurements on clouds in the middle that would swap the entanglement to the clouds on the ends, stretching the entanglement twice as far. "This experiment is a big step toward a quantum repeater," Hanson says. But several aspects of the work need to be improved before it can be used to make a quantum repeater, Hanson says. In particular, the atom clouds do not yet hold their delicate quantum states long enough to allow the multiple linking needed in a quantum repeater. Pan agrees, but says his group is working on that and urges patience. "I think a true quantum network is at least 10 years away."

***Correction, 13 February, 4:30 p.m.:** The story has been updated to clarify that the experiment sets a new standard for the longest optical fiber used to entangle two quantum memories and not for the actual distance between the memories.

sciencemag.org, 13 February 2020

<https://www.sciencemag.org>

Minnesota cities could get power to ban pesticides as bee population falls

2020-02-16

Lawmakers may give cities throughout Minnesota the authority to ban some widely used pesticides as native bumblebee and pollinator populations continue to collapse. A measure introduced last week by state Rep. Jean Wagenius, DFL-Minneapolis, would essentially give cities their first chance in more than 30 years to have some form of local control over what pesticides can be used within their boundaries. It would grant each city the choice to issue a blanket ban on a group of pesticides that the Minnesota Department of Agriculture has labeled as lethal to pollinators. That list includes neonicotinoids, which are among the most prevalent insecticides used on Minnesota farms and have proved to be particularly harmful to pollinators. "Minnesotans should be able to protect pollinators if they want to," Wagenius said. "We value local control in this state, and we always have." A similar proposal that would have given the state's four largest cities broader authority to regulate pesticides failed last year.

It would grant each city the choice to issue a blanket ban on a group of pesticides that the Minnesota Department of Agriculture has labeled as lethal to pollinators.

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Concerns were raised at the time that each of the four cities would write their own rules, creating a patchwork of regulations that would make it difficult for homeowners and businesses such as landscapers, nurseries and pest control experts to know what products were legal from one city to the next. This proposal, however, would grant cities a much narrower exception, Wagenius said. They would pretty much be making a single choice — whether or not to ban a list of “pollinator lethal” insecticides kept by the state. “This is designed to keep everything consistent,” she said. But the ban would still be enacted from city to city and create the same hard-to-navigate patchwork of rules, said Scott Frampton, past president of the Minnesota Nursery and Landscape Association. “Local governments lack the expertise and resources needed to assess and restrict these products,” Frampton said. Nearly all insecticides are lethal to pollinators, he said. If cities were to enact a blanket ban, it could keep homeowners from using treatments to fight invasive pests like the emerald ash borer. “Every product that effectively controls the ash borer contains pollinator lethal language,” Frampton said. But cities would be able to work with the Department of Agriculture, businesses and residents who would be effected by any restrictions before enacting them, said Patrick Hanlon, director of environmental programs for the city of Minneapolis. “This would be a tool in the tool belt,” he said. Rick Hansen, DFL-South St. Paul, said pesticide users and manufacturers have been making “apocalyptic arguments” for more than 30 years about what will happen if certain insecticides are banned. “Well, in the meantime bad things have been happening and things are falling apart,” he said. Several species of bees, butterflies and moths have been brought to the brink of extinction in Minnesota over the past two decades. The population losses are largely because of the region’s switch to more intensive and single-crop farming, powerful new pesticides and the loss of food and habitat, according to the U.S. Fish and Wildlife Service. The agency estimates that the rusty patched bumblebee, Minnesota’s fat and fuzzy state bee, has lost 90% of its population in the last 20 years, and that the bees are left in only 0.1% of their historical range. The Minnesota Department of Natural Resources spent three years from 2014 to 2016 surveying more than 63 prairie sites looking for 13 butterfly species known to live in the state’s prairies. It found evidence that just six were still there. Beekeepers and environmental groups praised the proposal, saying it recognizes how important cities and urban areas are becoming for bee habitat. Lately, rusty patched bees are rarely, if ever, spotted in places other than major cities. More than 40 cities in the state have declared themselves to be “pollinator friendly,” and more are adopting rules and programs to help homeowners and schools plant wildflowers, milkweed and other native grasses to turn lawns

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into pollinator habitats. Much of that work is undone when insecticides simply kill off native bumblebees or collapse a honeybee colony, said Willa Childress, Minnesota organizer for Pesticide Action Network North America. "I think legislators have seen how popular these [lawn conversion] programs are, and how much concern there is for pollinators in really every part of the state," Childress said. "The idea of keeping the status quo or business as usual looks pretty bleak."

startribune.com, 16 February 2020

<https://www.startribune.com>

Digging up the dirt: are your home-grown veggies safe to eat?

2019-11-22

The level of heavy-metal contamination in Australian gardens is being exposed by a Macquarie University program which is testing thousands of soil samples sent in by concerned citizens. Growing your own vegetables is supposed to be healthy but how much do you know about the soil they're growing in? There could be metal contaminants in it and they could be getting into your crop. Fortunately, there's an easy way to find out if your soil is OK using the VegeSafe program, a citizen science endeavour being run by Environmental Science staff at Macquarie University in partnership with Olympus, who manufactured a portable soil analysis device. Soil can pick up metal particles from many sources and these particles can remain for many years, says Professor Mark P Taylor, who is the Director of Macquarie University's Energy and Environmental Contaminants Research Centre. "Your garden soil could still contain lead deposited back before leaded petrol was banned in 2002, from previous land use or residue from old-style lead paints. The allowable limit of lead in house paint was reduced to 0.01 per cent in 1991, down from a staggering 50 per cent before 1965," Taylor said. "Lead is not a nutritious trace element in your carrots: it's a neurotoxin. Brain damage from lead exposure is irreversible. "Other metals, such as arsenic, cadmium, chromium, copper, manganese, nickel and zinc won't do you any good either if there are high concentrations in your soil. They might not be harmful for adults but children are more vulnerable. Toxic doses are lower for smaller bodies and children are more likely to stick their dirty fingers in their mouth."

High-tech tests

Members of the public can send samples of their garden soil for analysis – and more than 3000 people have so far sent upwards of 15,000 soil samples.

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VegeSafe is a citizen science program, probably the largest of its kind in the world, and is supported by public donations, of both funding and soil samples. Members of the public can send samples of their garden soil for analysis – and more than 3000 people have so far sent upwards of 15,000 soil samples. The VegeSafe team performs high-tech testing of these samples and provides the senders with a short report, as well as advice on things they can do to reduce the hazard if their soil is contaminated. The work has attracted worldwide interest and Taylor's group has now combined with researchers in the US to produce an [interactive mapping tool of residential environmental contamination](#). The program is also starting in New Zealand in early 2020. VegeSafe was recently named as Olympus Analytical Instrumentation's Research Partner of the year, in recognition of the scientific and social value of the work it performs using X-ray fluorescence technology. If you are worried about the risk of metal contamination, you should arrange to get the soil tested before buying or renting a home, and before building a vegetable garden or chicken run. You can also organise testing for house paint dating from before 1997, ceiling dust from before 2002 and all rainwater tanks. If the results are unfavourable, there are a range of things you can do to minimise potential harm. You can find out more from [VegeSafe](#).

[lighthouse.mq.edu.au](https://www.lighthouse.mq.edu.au), 22 November 2019

<https://www.lighthouse.mq.edu.au>

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Largest ever polar research expedition uses the Delta-T Devices SPN1 Pyranometer to measure solar radiation

2020-02-18

Delta-T Devices's SPN1 Sunshine Pyranometer is amongst instruments being used on a one-year long expedition to the Central Arctic. This major research project, titled MOSAiC (Multidisciplinary drifting Observatory for the Study of Arctic Climate) is closely analysing the Arctic (as the epicentre of global warming) in order to gain fundamental insights about the nature of global climate change. Over 500 hundred scientists from 20 countries are involved in the expedition, which is focused around a research icebreaker ship operating close to the North Pole for 12 consecutive months. The meteorological and environmental data gathered is expected to provide scientists with critical new information regarding global warming. The SPN1 Sunshine Pyranometer is being deployed by the expedition team (as part of the U.S. Department of Energy's Atmospheric Radiation Measurement (ARM) IceRad system) to measure global and diffuse solar radiation alongside sunshine hours. The SPN1 offers an internally heated, compact and highly rugged solar measurement solution. It is ideal for use in extreme environments as it features no moving parts and requires no adjustment during use. Delta-T Devices Sales Manager David Frew said, "The SPN1 Pyranometer is being adopted by some of the most prestigious research teams in the world, and we are very proud that our equipment is part of such an important research project as MOSAiC. Delta-T Devices has a particularly strong interest in assisting scientists to investigate climate change and food security issues, so MOSAiC aligns closely to our own concerns and goals. I believe that the SPN1's inclusion in this expedition reflects the confidence that the global research community has in Delta-T Devices instruments."

xprt.com, 18 February 2020

<https://www.xprt.com>

FIFA commits to carbon-neutral 2022 football World Cup

2020-02-18

FIFA aims reach carbon neutrality at the next World Cup, to be hosted by Qatar in 2022, in spite of the numerous environmental challenges linked to the location of the event, according to a recently released sustainability strategy. FIFA wants to "set a benchmark for environmental stewardship" during the next football World Cup "by implementing

The SPN1 offers an internally heated, compact and highly rugged solar measurement solution

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leading sustainable building standards, waste and water management practices and low-emission solutions". The organisers' objective is "to reach carbon neutrality before the tournament kicks off and leverage the event to leave a climate legacy for Qatar and the region," FIFA said. The international football organisation has "underlined its commitment to organising a carbon neutral and sustainable FIFA World Cup in Qatar," said Federico Addiechi, Head of Sustainability & Diversity at FIFA in a [statement released in November](#). In January, FIFA has fleshed out its strategy, [outlining 22 sustainability-related objectives](#). Those are based on designing, constructing and operating the facilities in a sustainable way, in order to minimise or offset polluting emissions resulting from the event. The strategy also aims at lowering and better managing waste as well as limiting the use of water.

From construction to management

To host the World Cup, Qatar will need to build or refurbish at least eight stadiums, plus training sites and temporary infrastructures. All this has an important carbon footprint and the same goes for operating the actual event.

But FIFA has demanded that stadiums be "designed and built following sustainable building standards" in order to reduce the negative ecological impact. This includes prioritising the use of recycled and recyclable materials and reducing carbon emissions as low as possible.

The football organisation will assess the environmental impact of stadiums based on the Global Sustainability Assessment System (GSAS), a performance-based green building certification system developed and used by the Gulf Cooperation Council countries. The GSAS looks at urban connectivity, site, energy, water, materials, indoor environment, cultural & economic value, as well as management and operations. According to FIFA, all the stadiums that will host the World Cup are "on track" to qualify for the certificate while the Khalifa International and Al Janoub Stadiums achieved it in 2017 and 2019 respectively. These stadiums are expected to exhibit energy savings of up to 47% and water savings of around 44%, the organisation claims. A study conducted in England has listed its football teams according to their environmental performance and four Premier League clubs – Arsenal, Manchester City, Manchester United and Tottenham – are leading the table.

Pending challenges

Like any other big event, the organisation of the World Cup is an important source of carbon emissions, from transport to energy production and food.

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However, the choice of Qatar as host of the event poses particular challenges for the environment, starting with the remote location, which makes flying the only transport option for most of the football teams. The energy production in Qatar, based on fossil fuels, represent another enormous challenge for FIFA to achieve a carbon-neutral tournament. Furthermore, Qatar is lagging behind when it comes to waste management. The country's recycling rate reaches only 10% compared to the EU's 55%, for instance. FIFA prefers looking at the bright side, saying the World Cup will be "a catalyst to promote the development and uptake of waste management and recycling solutions" in Qatar. But their strategy hardly focuses on improving the country's waste management system. Rather, raising awareness and reducing waste seem to be the goals.

Emission reduction

Long criticised over their lack of transparency, the organisers have committed to providing clarity on climate action by putting together a greenhouse gas emissions inventory for the preparation, the staging and the post-event activities, including reducing and offsetting emissions. FIFA wants to minimise the tournament's carbon footprint by promoting the use of renewable energies, and energy-efficient equipment. It also wants to encourage the use of public transport that will be further developed ahead of the event and deploy a fleet of low-emission vehicles to help people move around during the tournament. This will also help reduce air pollution, a serious challenge for Qatar which has vowed to improve the situation by 2022. During the tournament, the facilities will be surrounded by green spaces to improve air quality. The organisers want to raise awareness among the public on how to reduce or offset their emissions and FIFA has said it will implement its own programme to offset the remaining emissions.

[euractiv.com](https://www.euractiv.com), 18 February 2020

<https://www.euractiv.com>

Unusual Arctic warming explained by overlooked greenhouse gases

2020-01-21

The same gases that caused holes in Earth's ozone layer in the past century are responsible for the rapid warming of the Arctic as well, according to a new study published in *Nature*. Scientists looked at the effect of these gases in climate simulations between 1955 and 2005. They found that

They found that the gases accounted for up to half of the warming and sea-ice loss of the Arctic during that period, Nature reports

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the gases accounted for up to half of the warming and sea-ice loss of the Arctic during that period, *Nature* reports. These so-called ozone-depleting substances (ODSs) are considered potent greenhouse gases and include organic chlorine and bromine compounds such as chlorofluorocarbons. The researchers also concluded that the warming was caused directly by the gases and not because of their interactions with the ozone layer. ODSs in the atmosphere are declining since they were banned in the 1980s, following concerns over the ozone layer hole over Antarctica. Scientists would need to replicate these findings in order to explore the contribution of ODSs to global warming during the past decades.

sciencemag.org, 21 January 2020

<https://www.sciencemag.org>

Electric bacteria create currents out of thin—and thick—air

2020-02-17

Generating electricity from thin air may sound like science fiction, but a new technology based on nanowire-sprouting bacteria does just that—as long as there's moisture in the air. A new study shows that when fashioned into a film, these wires—protein filaments that ferry electrons away from the bacteria—can produce enough power to light a light-emitting diode. The film works by simply absorbing humidity from the surrounding air. Though researchers aren't sure exactly how these wires work, the tiny power plants pack a punch: Seventeen devices linked together can generate 10 volts, which is enough electricity to power a cellphone. The new method should be considered a "milestone advance" says Guo Wanlin, a materials scientist at Nanjing University of Aeronautics and Astronautics who wasn't involved with the work. Guo studies hydrovoltaics, a molecular approach to harvesting electricity from water. The way hydrovoltaic devices work is still a bit of a mystery. When water droplets interact with certain kinds of graphene or other materials, an electric charge is generated, and electrons move through the materials. Many questions remain about exactly how these devices generate electricity, however. "I think a deeper understanding ... is needed," says Dirk de Beer, a microbiologist developing microsensors at the Max Planck Institute for Marine Microbiology. Researchers are also just starting to learn how electron-conducting bacteria function. More than 15 years ago, co-author Derek Lovley, a microbiologist at the University of Massachusetts (UMass), Amherst, and his colleagues discovered that a bacterium called *Geobacter* shuttles electrons from organic material to metal-based

When water droplets interact with certain kinds of graphene or other materials, an electric charge is generated, and electrons move through the materials.

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compounds, such as iron oxides. Since then, he and others have learned that many other bacteria make protein nanowires to transfer electrons to other bacteria or sediment in their environments. This transfer **creates a small electrical current**, which researchers have tried with mixed success to harness as clean energy. But 2 years ago, UMass graduate student Liu Xiaomeng noticed that sometimes the isolated nanowires spontaneously generated current. At first, his adviser, UMass electrical engineer Yao Jun, was skeptical, but eventually, they discovered that when they sandwiched a thin film of the nanowires between two gold plates—which serve as electrodes—and left it sitting out, they could consistently get power for at least 20 hours (right). And the device could recharge itself. The trick was to have the top plate smaller than the bottom, leaving one side of the nanowire film exposed to humid air. They knew the nanowires couldn't be pulling electrons from the gold plates, because using plates made of carbon—which are not ready sources of electrons—worked just as well. The researchers ruled out another possibility: that the protein nanowires themselves were disintegrating and setting their own electrons free. A third idea came up: Sometimes light can free electrons by triggering chemical reactions. But the nanowires' current flowed even in the dark. The researchers had one final clue: When they put the nanowires in a less humid chamber, the current decreased, suggesting moisture was key. They then exposed their device to different levels of humidity. It worked best in **air of about 45% humidity**, but also in conditions **as dry as the Sahara Desert or as humid as New Orleans**, the team reports today in *Nature*. The secret, they say, is that with just the upper side of the film absorbing moisture, a moisture gradient develops, with droplets constantly diffusing in and out of the top. The droplets can dissociate into hydrogen and oxygen ions, causing charges to build up near the top. The difference in charge between the top and bottom of the film causes electrons to flow, Yao explains. Using water vapor is "a revolutionary technology to get renewable, green, and cheap energy directly from atmospheric moisture," says Qu Liangti, a materials scientist at Tsinghua University. But previous attempts to wring energy from moisture, such as using graphene or polymers, produced small amounts of current for only brief periods of time. In the new setup, spaces in between the nanowires seem to help maintain the moisture gradient, enabling power generation for 2 months and more, Yao's team reports. So out of the gate, the new setup lasts weeks rather than seconds, and it has more than 100-fold the power output of previous devices. And because the "air-gen," as Yao calls the electrode-and-nanowire device, requires no external power, it can be used in many more places than solar panels or wind turbines. If it can be scaled up, it shows "great potential for practical applications," Guo says.

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And Lovley has proposed a way to do that. Growing *Geobacter* to harvest nanowires is difficult, so Lovley has **genetically engineered the easy-to-grow bacterium *Escherichia coli*** to produce nanowires. The *E. coli* created nanowires of the same diameter and **with the same conducting power** as *Geobacter's*, he and his colleagues reported in a November 2019 preprint posted to bioRxiv. But a ready source of nanowires might not be enough, says Gemma Reguera, a microbiologist at Michigan State University who has used *E. coli* to make peptides that are the protein nanowires' building blocks. For now, the device relies on *Geobacter's* nanowires. Because shearing nanowires off *Geobacter* can yield wires of different compositions, "It's not exactly clear what they are probing" when Yao and Lovley experiment with their air-gen, she says. (Lovley thinks they do know what the wires are made of.) De Beer also has reservations: "This paper made me a bit concerned," he says. Air-gen seems to provide an infinite power source, but he doesn't see how, because there is no clear source of electrons.

sciencemag.org, 7 February 2020

<https://www.sciencemag.org>

The real 'paleo diet' may have been full of toxic metals

2020-02-14

You'll be healthier if you ate as your ancestors did. At least that's the promise of some modern fads such as the "caveman" or paleo diet—characterized by avoiding processed food and grains and only eating things like meat, fish, and seeds. But a new study suggests the food some early humans in Norway ate may have not only been unhealthy, but downright toxic. In some cases, these people may have consumed more than 20 times the levels of dangerous metals recommended for humans today. "This study raises interesting ideas," says Katheryn Twiss, an archaeologist at Stony Brook University who was not involved in the work. But, she notes, the findings are limited to a small number of animal remains from just a few sites, and therefore may not fully represent the diets of Norwegians from thousands of years ago. Pollutants have been entering our food chain for millennia. In 2015, for example, researchers reported that cod caught off the North American coast around 6500 years ago by Stone Age hunter-gatherers contained high levels of mercury. This metal occurs naturally in Earth's crust and is thought to have leached into the oceans in greater concentrations after sea level rise covered more land. Once in the water, fish absorb mercury through their gills and their food. To find out whether this problem was more widespread,

In some cases, these people may have consumed more than 20 times the levels of dangerous metals recommended for humans today.

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archaeologist Hans Peter Blankholm of the Arctic University of Norway and colleagues focused on Stone Age humans living on the shores of the Norwegian Arctic, in an area known as Varanger. The researchers selected eight archaeological sites from the region, spanning 6300 to 3800 years ago. They did not study any human remains; instead, they analyzed the bones of dozens of Atlantic cod and harp seals found in ancient garbage pits. The majority of the cut marks on the seal bones suggest the animals were butchered for their meat, rather than simply skinned. Both species were among the main ingredients in the diet of the people who lived here, according to previous archaeological studies. The hunter-gatherers are also known to have eaten haddock, whale, dolphin, reindeer, and beaver. The bones of the cod at these sites contained more than 20 times the maximum level of cadmium and up to four times the highest level of lead that the European Food Safety Authority considers safe in meat, the team reports in *Quaternary International*. Cadmium can cause kidney, liver, and lung disease, while lead can impair the brain and nervous system. Seal bones at the sites contained up to 15 times the recommended levels of cadmium and up to four times the recommended levels of lead. The level of mercury—which can cause damage to the brain, kidneys, and immune system in humans—was also high in both animals. As with the fish in the earlier study, the researchers believe rising sea level was responsible for the pollution in the food chain. Blankholm calls these levels of heavy metals in seafood “unhealthy, if not unsafe.” But he says it’s unclear how much the diet of these prehistoric people would have harmed them. Balancing the seal and cod with fruit or meat from reindeer and rabbits could have blunted the effects of the heavy metals. The Varanger people also may not have lived long enough to feel the full effects of the accumulating pollutants. The scientists may soon be able to shine a light on some of these outstanding questions: They have now acquired the remains of eight individual Stone Age humans from the Varanger region and can explore the potential effects of heavy metals on their health and lifespans. The researchers also hope to analyze additional animal remains. All of this may help to address what Twiss sees as a key weakness of the work so far: Researchers are using only 40 bones to draw conclusions about pollution levels across various sites and some 2500 years. Even if the cod and seal were contaminated by heavy metals, Twiss says, such meat would surely have also been a good source of protein and other key nutrients. So maybe this paleo diet wasn’t all bad after all.

sciencemag.org, 14 February 2020

<http://www.sciencemag.org>

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Novel Quantum effects found: Spin-rotation coupling

2020-02-18

Let's assume we are dancing on a meadow, quickly spinning about our own axis. At some point we hop on a rotating carousel. We may end up hurting ourselves when both rotations add up and angular momentum is transferred. Are similar phenomena also present in quantum mechanical systems? After years of preparation, a team at the TU Wien managed to conduct an experiment where the spin of a neutron traverses through a region with a rotating magnetic field. A special kind of coil had to be developed to produce this rotating magnetic field. Although the neutron spin does not carry any mass and can only be described quantum mechanically, it exhibits an inertial property. These results have now been published in Nature Partner Journal *Quantum Information*.

The Inertia of Rotation: Big Wheels Keep on Turning

"Inertia is a ubiquitous feature", Stephan Sponar of the Institute of Atomic and Subatomic Physics at TU Wien illustrates. "When we sit on a train which moves at constant speed, we cannot tell the difference to a train parked at the station. Only when changing the frame of reference, e.g. when jumping off the train, we are decelerated. We feel forces due to the inertia of our mass." When rotations are considered, things are similar: the angular momentum of a rotating object is conserved as long as no external torque is applied. But when considering quantum particles, things become more complicated: "Particles like neutrons or electrons feature a special kind of angular momentum - the spin", says Armin Danner, lead author of the newly published paper. Spin is the intrinsic orbital angular momentum of an elementary particle. There are similarities to the rotation of a planet rotating about its axis, but in many regards this comparison does not hold: the spin is a property of pointlike particles. With a classical mindset, they cannot rotate about any axis. "Spin can be regarded as the angular momentum of an object which is constricted to a point," Armin Danner says. The properties of such a spin are not to be found in our everyday life. But the formalism of quantum mechanics can give us an intuitive idea how things work for some cases.

Coupling Between Spin and Magnetic Field

"Way back in 1988, colleagues already predicted how a neutron should behave when it is suddenly exposed to rotation", Prof. Yuji Hasegawa, head of the neutron interferometry group, explains. "A coupling between the neutron spin and a rotating magnetic field was predicted. But until now, no one could directly demonstrate this coupling in its quantum

Although the neutron spin does not carry any mass and can only be described quantum mechanically, it exhibits an inertial property

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mechanical form. It also took us a few years of work and several attempts to do that." Similar to a dancer which has spin and crosses a rotating carousel, the neutron is exposed to a rotating magnetic field. This field manipulates the spin, however, the spin orientations before and after the magnetic field are the same. After traversing the region with the magnetic field, the angular momentum of the neutron is exactly the same as before. The only thing that "happened" to the neutron is that it experienced effects of inertia, which are detectable by means of quantum mechanics. In the experimental setup, the neutron beam is split into two separated partial beams. One of them is exposed to a rotating field while the other is unaffected. Both partial beams are then recombined. Following the rules of quantum mechanics, the neutron travels along both paths simultaneously. In the first path, effects of inertia locally change the wavelength of the particle-wave. This determines how the partial waves amplify and extinguish each other. The biggest challenge was the design of the magnetic coil which produces the magnetic field. A small window inside the coil is needed for the neutron beam to pass through. However, the field properties must comply with the strict conditions to induce the desired field. A suitable geometry was identified with the help of computer simulations. The system was developed and tested at the neutron source of the TU Wien in the Viennese Prater while the final measurements were conducted at the ILL in Grenoble, France. "It is fascinating that we induced a pure quantum effect which at first cannot be understood classically," Armin Danner points out. "Our intuition should therefore not help us here at all. But we could demonstrate for a very specific case that the classical concept of inertia is still valid for the neutron spin."

eurekalert.org, 18 February 2020

<http://www.eurekalert.org>

Sinkevicius: Dealing with PFAS chemicals in revised tap water rules was a 'great move'

2020-02-12

The inclusion of per- and poly-fluoroalkyl substances (PFAS) into the EU's Drinking Water Directive was a step forward that showed the EU's commitment to address these chemicals, Environment Commissioner Virginijus Sinkevičius told EURACTIV. Promoting his movie *Dark Waters*, Hollywood actor Mark Ruffalo spoke at the European Parliament, bringing a warning to Europe about PFAS pollution of drinking water. PFAS are synthetic chemicals used in a wide variety of industrial and

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consumer products such as adhesives, cosmetics and cleaning products. In December, the European Environmental Agency (EEA) presented an [overview](#) of the known and potential risks that PFAS chemicals pose to human health and the environment. The agency estimated the costs linked to human health and remediation to €10 billion every year. At the end of last year, the European Union reached a provisional agreement on updating the parameters of water for human consumption, which included tap water limits for the 20 most important of the 4,700 PFAS substances. The Commission will also develop a method for measuring all PFAS in the coming years. The European Parliament and the EU Council will then set a new limit value for all 4,700 substances on the basis of the Commission's method. The revised drinking water directive still needs the final approval from both the European Parliament and EU member states. Last December, four member states called on the EU executive to develop an action plan to phase out PFAS by 2030, allowing only essential uses. They made their demands heard in a letter sent to Frans Timmermans, the Commission vice-president in charge of the Green Deal. For Sinkevicius, the main piece of legislation for coping with hazardous chemicals will be the sustainable EU chemicals policy strategy, although the issue could be raised in the new Circular Economy Action Plan too. "The new chemical strategy is going to be out in Summer and we'll be definitely consulting stakeholders in order to deliver the best possible results," he said. "Our goal is very clear. It's a zero-pollution ambition to protect our citizens," he added.

euractiv.com, 12 February 2020

<http://www.euractiv.com>

Treatment Solutions for Meat-Processing Wastewater

2020-02-07

When treating waste streams with a high organic load, waste-to-energy tech can improve effluent quality and help pay for itself. The world consumes a lot of meat. One estimate is that by 2050, approximately 465 million metric tons of beef, poultry, pork, and other meats will be produced annually. Much of it will be processed in slaughterhouses, using processes that are particularly water-intensive. For example, in cattle slaughterhouses, wastewater streams typically include processing water from the slaughtering line as well as from cleaning, producing a highly variable organic load of fats and other animal waste products. Poultry, egg, and dairy production also produce a wide range of animal wastes. Untreated slaughterhouse wastewater streams, with their high biological

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oxygen demand (BOD) and chemical oxygen demand (COD), can create severe problems for municipal sewage treatment systems. Because of this, in-house wastewater treatment is a top priority for the meat industry, but one that comes with many challenges.

Solutions for Food Processing Waste

Because of the challenges presented by meat-processing wastewater, several types of treatment are typically involved. Dissolved air flotation (DAF), one of the first stages, is used to remove suspended particles from the wastewater. DAF removes roughly 80% of organic load and 65% of nitrogen load. After this stage, the sludge is usually treated using anaerobic digestion. Anaerobic digestion relies on microorganisms to break down biodegradable material in the absence of oxygen. It can be used to process a wide range of organic material, from food and animal waste to grass and paper waste. Anaerobic digestion has an added benefit: The process produces biogas — primarily methane (CH₄) and carbon dioxide (CO₂) — which can be converted into electrical and thermal energy. This clean, reliable source of energy allows food-processing facilities such as slaughterhouses not only to offset operating costs, but also to turn waste into an income source. Fabio Poletto, General Manager of Fluence Italy, explained in an interview with Water Online, "It's useful to know that 1 ton of floated sludge at 10% digested mass can produce up to 60 m³ of methane." After anaerobic digestion, the remaining mass — known as digestate — is separated by consistency. Solid sludge, usually less than 20% of the incoming waste stream, can be used or further treated and sold as fertilizer. Liquid digestate is subjected to additional processes, which may include nitrification and denitrification to meet target standards. Fluence's membrane aerated biofilm reactor (MABR) wastewater treatment technology excels at denitrification, recently being tested to meet stringent California Title 22 standards and PRC Class 1A standards in China. MABR also has slashed the energy requirements of WWT while shrinking the required footprint. The technology is available skid-mounted, in plug-and-play Aspiral™ units, or as submersible SUBRE units for retrofitting legacy plants.

Energy From Food Waste

As a bonus, these processes, when balanced properly, can lower operational and capital expenditure. This is especially true for waste-to-energy technologies like anaerobic digestion. Of the 1.3 billion tons of food wasted worldwide each year, less than 11% is converted to energy. If half the food waste generated in the United States were treated using

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anaerobic digestion, it would generate enough electricity to power more than 2.5 million homes for a year, according to the U.S. Environmental Protection Agency. The amount of biogas generated from food waste depends on its moisture content and composition. Food waste with low moisture content will generate more biogas, as will fats and proteins. But, when it comes to the bottom line, does waste-to-energy make sense? In fact, operators of such systems know they may pay for themselves. Poultry processing companies like Italy's Avimecc Group — which processes 40,000 chickens a day — are realizing savings with Fluence waste-to-energy systems, and Fluence is currently installing a 1.7 million waste-to-energy system for ArreBeef Energia in Argentina.

Retrofitting Existing Operations

Retrofitting an existing wastewater treatment system may seem daunting when an operation can't be shut down for construction. But when respected Italian poultry processing company Amadori was outgrowing its wastewater treatment plant and wanted to lower disposal cost, it contacted Fluence, which designed, built, and commissioned an anaerobic digestion and nitrification-denitrification system within the plant. The completed 3,180 m³/d retrofit includes DAF pretreatment, anaerobic digestion, dehydration, nitrification-denitrification, and a final clarifier. It produces 3,600 Nm³/d of valuable methane to fuel a cogenerator while producing effluent that meets EU environmental standards. No break in operation was necessary for Fluence to design, build, and commission the retrofit.

xprt.com, 7 February 2020

<http://www.xprt.com>

Lab turns trash into valuable graphene in a flash

2020-01-27

That banana peel, turned into graphene, can help facilitate a massive reduction of the environmental impact of concrete and other building materials. While you're at it, toss in those plastic empties. A new process introduced by the Rice University lab of chemist James Tour can turn bulk quantities of just about any carbon source into valuable graphene flakes. The process is quick and cheap; Tour said the "flash graphene" technique can convert a ton of coal, food waste or plastic into graphene for a fraction of the cost used by other bulk graphene-producing methods. "This is a big deal," Tour said. "The world throws out 30% to 40% of all food, because it goes bad, and plastic waste is of worldwide concern.

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We've already proven that any solid carbon-based matter, including mixed plastic waste and rubber tires, can be turned into graphene." As reported in *Nature*, flash graphene is made in 10 milliseconds by heating carbon-containing materials to 3,000 Kelvin (about 5,000 degrees Fahrenheit). The source material can be nearly anything with carbon content. Food waste, plastic waste, petroleum coke, coal, wood clippings and biochar are prime candidates, Tour said. "With the present commercial price of graphene being \$67,000 to \$200,000 per ton, the prospects for this process look superb," he said. Tour said a concentration of as little as 0.1% of flash graphene in the cement used to bind concrete could lessen its massive environmental impact by a third. Production of cement reportedly emits as much as 8% of human-made carbon dioxide every year. "By strengthening concrete with graphene, we could use less concrete for building, and it would cost less to manufacture and less to transport," he said. "Essentially, we're trapping greenhouse gases like carbon dioxide and methane that waste food would have emitted in landfills. We are converting those carbons into graphene and adding that graphene to concrete, thereby lowering the amount of carbon dioxide generated in concrete manufacture. It's a win-win environmental scenario using graphene." "Turning trash to treasure is key to the circular economy," said co-corresponding author Rouzbeh Shahsavari, an adjunct assistant professor of civil and environmental engineering and of materials science and nanoengineering at Rice and president of C-Crete Technologies. "Here, graphene acts both as a 2D template and a reinforcing agent that controls cement hydration and subsequent strength development." In the past, Tour said, "graphene has been too expensive to use in these applications. The flash process will greatly lessen the price while it helps us better manage waste." "With our method, that carbon becomes fixed," he said. "It will not enter the air again." The process aligns nicely with Rice's recently announced Carbon Hub initiative to create a zero-emissions future that repurposes hydrocarbons from oil and gas to generate hydrogen gas and solid carbon with zero emission of carbon dioxide. The flash graphene process can convert that solid carbon into graphene for concrete, asphalt, buildings, cars, clothing and more, Tour said. Flash Joule heating for bulk graphene, developed in the Tour lab by Rice graduate student and lead author Duy Luong, improves upon techniques like exfoliation from graphite and chemical vapor deposition on a metal foil that require much more effort and cost to produce just a little graphene. Even better, the process produces "turbostratic" graphene, with misaligned layers that are easy to separate. "A-B stacked graphene from other processes, like exfoliation of graphite, is very hard to pull apart," Tour said. "The layers adhere strongly together. But turbostratic graphene is much easier to

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work with because the adhesion between layers is much lower. They just come apart in solution or upon blending in composites. "That's important, because now we can get each of these single-atomic layers to interact with a host composite," he said. The lab noted that used coffee grounds transformed into pristine single-layer sheets of graphene. Bulk composites of graphene with plastic, metals, plywood, concrete and other building materials would be a major market for flash graphene, according to the researchers, who are already testing graphene-enhanced concrete and plastic. The flash process happens in a custom-designed reactor that heats material quickly and emits all noncarbon elements as gas. "When this process is industrialized, elements like oxygen and nitrogen that exit the flash reactor can all be trapped as small molecules because they have value," Tour said. He said the flash process produces very little excess heat, channeling almost all of its energy into the target. "You can put your finger right on the container a few seconds afterwards," Tour said. "And keep in mind this is almost three times hotter than the chemical vapor deposition furnaces we formerly used to make graphene, but in the flash process the heat is concentrated in the carbon material and none in a surrounding reactor. "All the excess energy comes out as light, in a very bright flash, and because there aren't any solvents, it's a super clean process," he said. Luong did not expect to find graphene when he fired up the first small-scale device to find new phases of material, beginning with a sample of carbon black. "This started when I took a look at a Science paper talking about flash Joule heating to make phase-changing nanoparticles of metals," he said. But Luong quickly realized the process produced nothing but high-quality graphene. Atom-level simulations by Rice researcher and co-author Ksenia Bets confirmed that temperature is key to the material's rapid formation. "We essentially speed up the slow geological process by which carbon evolves into its ground state, graphite," she said. "Greatly accelerated by a heat spike, it is also stopped at the right instant, at the graphene stage." It is amazing how state-of-the-art computer simulations, notoriously slow for observing such kinetics, reveal the details of high temperature-modulated atomic movements and transformation," Bets said. Tour hopes to produce a kilogram (2.2 pounds) a day of flash graphene within two years, starting with a project recently funded by the Department of Energy to convert U.S.-sourced coal. "This could provide an outlet for coal in large scale by converting it inexpensively into a much-higher-value building material," he said.

sciencedaily.com, 27 January 2020

<http://www.sciencedaily.com>

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New biochemical compound breaks down environmental pollutants

2020-02-18

Enzymes with flavin cofactor play an important part in plants, fungi, bacteria and animals: as oxygenases they incorporate oxygen into organic compounds. For instance this allows people to excrete foreign substances more effectively. Until now scientists were agreed that such flavin-dependent oxygenases use flavin C4a-peroxide as oxidizing agent. This is formed by the C4a-atom of the flavin cofactor reacting with atmospheric oxygen (O_2), before one of the two oxygen atoms are transferred to the compound. A team headed by Dr. Robin Teufel from the Institute of Biology II at the University of Freiburg has discovered that O_2 also reacts to flavin N5-peroxide with the N5-atom of the flavin cofactor. The researchers have published their results in the journal *Nature Chemical Biology*. The newly-discovered flavin N5-peroxide has different reactive characteristics than the flavin C4a-peroxide. Some bacteria use this to break down stable chemical compounds, including environmental pollutants such as dibenzothiophene, a component of crude oil, or hexachlorobenzene, a plant protection agent. Using X-ray structural analysis and mechanistic studies the scientists were able to clarify how the formation of this flavin N5-peroxide is controlled at an enzymatic level. In future Teufel and his team want to study how widespread this novel flavin biochemistry is in nature. They also want to improve understanding of the role, reactivity and functionality of the flavin N5-peroxide. With their work they are enabling further studies that will in future allow the prediction of flavin enzyme functionality or modification using biotechnology. Robin Teufel and his work group are studying enzymatic reactions of the bacterial metabolism at the Institute of Biology II of the University of Freiburg.

sciencedaily.com, 18 January 2020

<http://www.sciencedaily.com>

A team headed by Dr. Robin Teufel from the Institute of Biology II at the University of Freiburg has discovered that O_2 also reacts to flavin N5-peroxide with the N5-atom of the flavin cofactor.

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A urinary metabolomic study from subjects after long-term occupational exposure to low concentration acrylamide using UPLC-QTOF/MS

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his study identifies important related metabolic changes in the bodies of workers after long-term occupational exposure to low concentration ACR and suggests new biomarkers of nervous system injury caused by ACR.

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