Bulletin Board

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CHEMWATCH

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ASIA PACIFIC

Final report — Secondary notification assessment on Irgalube 232

2019-04-05

The National Industrial Chemicals Notification and Assessment Scheme (NICNAS) recently published the completed secondary notification assessment on Irgalube 232. NICNAS has given notice that Irgalube 232 is no longer a chemical requiring secondary notification. However, manufacturers and importers of the chemical remain obliged to advise the Director of relevant changes in circumstances.

Consultation and communication process

Secondary notification timeline:

- draft report released to the applicants for feedback from 19 November to 17 December 2018 (as required by section 60D of the Act)
- draft report released for public comment from 22 January to 5 March 2019 (as required by section 60E of the Act)
- final report published 2 April 2019 (in accordance with section 60F of the Act).

Further information is available at: Download the final secondary notification assessment report on Irgalube 232 [PDF 1.4MB]

NICNAS Chemical Gazette, 2 April 2019

http://www.nicnas.gov.au

The National Industrial Chemicals Notification and Assessment Scheme (NICNAS) recently published the completed secondary notification assessment on Irgalube 232.

Reminder: Workplace exposure standards open for public comment

2019-04-05

Safe Work Australia has issued a reminder about submitting comments on the recommended values for respirable crystalline silica and respirable coal dust. The agency is currently evaluating the *Workplace exposure standards for airborne contaminants* to ensure they are based on the highest quality evidence and supported by a rigorous scientific approach. Safe Work Australia will be seeking comments on the draft evaluation reports and recommendations for the workplace exposure standards (WES) throughout 2019, beginning with respirable crystalline silica

and respirable coal dust. In particular, the agency is seeking technical comments regarding:

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

Comments can be submitted at the Safe Work Australia consultation platform Engage. Safe Work Australia must receive comment by 30 April 2019. Feedback will be considered when making final recommendations regarding the workplace exposure standards. You can stay informed about the review and release dates for other chemicals by subscribing to the 'chemical exposure standards' mailing list.

Safe Work Australia, 3 April 2019

http://www.safeworkaustralia.gov.au

Results of EPA investigation into PFOS firefighting foams

2019-04-04

An investigation conducted by New Zealand's Environmental Protection Authority has found stores of firefighting foams containing a banned chemical, PFOS (perfluorooctane sulfonate), across New Zealand. At all sites where the banned foam was identified, including those which are not yet fully compliant, the foam has been secured within equipment, and secured against use. The foam is not accessible to the public and there is no public risk. It is appropriately labelled to warn workers of the hazards. PFOS foams were excluded from the Firefighting Chemicals Group Standard in 2006, meaning they could no longer be imported into New Zealand. In 2011, all PFOS products were completely banned and strict controls were set to manage their storage and disposal. The aim of our investigation was to discover whether PFOS-containing foams had been imported, manufactured, used, stored, or disposed of in New Zealand in contravention of Hazardous Substances and New Organisms Act 1996 (HSNO) requirements, and the extent of these activities. The EPA sought to ensure any non-compliant foam was removed and disposed of safely; that any places or equipment in contact with the foam were decontaminated, and that clean-up materials were appropriately disposed of.

An investigation conducted by New Zealand's Environmental Protection Authority has found stores of firefighting foams containing a banned chemical, PFOS (perfluorooctane sulfonate), across New Zealand.

Chief Executive Dr Allan Freeth says: "Our investigation covered 166 sites across the country. We were very surprised to find the banned foams at six airports; in equipment owned by two companies that service airports;

at three sites controlled by a major oil company; in two tug boats; and at a tyre company. "Firefighting foam with lower levels of PFOS was also found at some other sites. These lower levels likely resulted from contamination arising from previous use of PFOS foams. "In all cases, operators have taken the EPA's direction and complied with storage and labelling laws. Any ongoing risks to the environment have been mitigated. "In all instances, our aim was to secure the best outcome by working with parties, either on a voluntary basis or via a compliance order, to ensure they took the necessary steps to decontaminate or dispose of the foam in line with technical standards. "I want to stress that we found no intentional non-compliance. We concluded it was highly likely that all the banned foam we identified had been imported before 2006, when it was legal. There is, however, no excuse when businesses that are part of the professional firefighting sector do not keep up to date with law changes in their industry. "Three compliance orders were issued early in the investigation to reflect the seriousness of the public and environmental issues arising from use of these foams. A later compliance order was served on an operator in response to its reluctance to take action. "We consider that we have met the objectives of our investigation. While no prosecutions were undertaken, enforcement and compliance action has been successful. We remain vigilant and will take very seriously any circumstances where we might find banned foam being used or stored illegally in the future. "This investigation was a first for the EPA. Changes to HSNO Act, which came into force on 1 December 2017, gave us new enforcement powers which allowed us to take action on non-compliance. We initiated this independent investigation 19 days later. "Because of the protracted nature around safe disposal of the banned foam, we cannot yet verify that full compliance with legal requirements has been achieved in all cases. However, substantial progress has been achieved, and EPA investigators will continue to work towards ensuring that all PFOS foams are safely removed and disposed of, eliminating the threat of any future contamination of the New Zealand environment." A copy of the full report is available at: Full report

Background information

The New Zealand Defence Force (NZDF) discovered soil and water contamination from PFOS, and a related substance PFOA, at its Ohakea and Woodbourne airbases. The source was thought to be a specialist firefighting foam used for combating liquid fuel fires. The foam may have been used at the airbases during training exercises, and during emergencies. On 7 December 2017 the Government announced an All-of-

Regulatory Update

Government investigation, and mitigation measures, for potential water contamination at Woodbourne and Ohakea airbases. The focus was to be on water contamination and land remediation for public health and safety.

PFOS (perfluorooctane sulfonic acid)

From the 1960s to the 1990s, firefighting foams containing PFOS were widely used internationally, including for firefighting training. They were the most effective means of extinguishing highly volatile, liquid fuel fires. So, they were often deployed at airports, oil facilities and military bases. They have a narrow and specific use, and would not be present in home fire extinguishers, for example. PFOS is classified as a Persistent Organic Pollutant (POP) under the Stockholm Convention, an international agreement on managing POPs to protect the environment and human health. New Zealand became a signatory to the Convention in May 2001. POPs are stable compounds that do not readily break down through chemical or biological processes. They persist for a long time, both in the environment and the human body, with potential health effects. Under the Stockholm Convention, POPs were banned in 2004. PFOS was listed as a POP, with effect from 2010.

Regulation of PFOS in New Zealand

In 2006 PFOS firefighting foams were excluded from the EPA's Firefighting Chemicals Group Standard, meaning they could no longer be imported into New Zealand, or manufactured here. A Group Standard is a process through which the EPA approves groups of similar substances for use in New Zealand under the Hazardous Substances and New Organisms Act 1996 (HSNO). In 2011, a Stockholm Convention decision recognising PFOS as a POP was written into New Zealand domestic law. This meant the use of PFOS products in New Zealand was banned completely and strict controls were set around their storage and disposal. The EPA reissued the 2006 Group Standard in 2017, to take into account changes brought about by health and safety reforms, but this did not lift the restriction on PFOS.

EPA investigation launched 20 December 2017

The EPA had assumed new enforcement powers following changes to the HSNO Act, which came into force from 1 December 2017. Using those powers, on 20 December 2017 the EPA announced it was launching an independent investigation to find out whether firefighting foams containing PFOS had been imported, manufactured, used, sourced or disposed of at places other than NZDF sites. The scope of the EPA's investigation was different from that run by the All-of-Government

group, as it is not responsible for finding or cleaning-up soil or water at contaminated sites. The EPA sought to ensure that any non-compliant foam was removed and disposed of in an approved, safe, way so it could never be used again. It also required that any places or equipment in contact with the foam were decontaminated, and that clean-up materials were appropriately disposed of.

Initial focus of investigation – airports

The EPA began by investigating airports, as the NZDF sites with suspected PFOS contamination were airbases. Commercial airports were the first priority – 14 were asked to provide information about their firefighting foams. Larger airports were contacted first, as they had their own dedicated firefighting resources. After this initial approach, a further 20 smaller airports were reviewed.

Next stage – identifying other sectors

The EPA used an evidence and risk-based approach to prioritise other sites that may have possessed, used or stored PFOS foams. Risk criteria considered were:

- volume of firefighting foam likely to be held
- sector size
- public risk
- EPA knowledge of the sector and its history

On this basis, the EPA selected as the next priority for investigation ports, refineries, bulk fuel storage sites and petrochemical sites. The third priority sector identified covered New Zealand-registered ships and shipping companies.

Focus on storage of foam

The investigation construed "use" of PFOS-contaminated foam to include foam stored in equipment, such as firefighting trucks or firefighting systems, or in containers, so that it is available for immediate use in an emergency.

Where PFOS-contaminated foam was unable to be replaced immediately (for example, for public safety in the event of an air crash), we allowed organisations to store it (in compliance with applicable EPA hazardous substances requirements) until a replacement could be found.

The EPA's approach to compliance

The EPA adopted the standard Voluntary, Assisted, Directed, Enforced (VADE) investigative model. This uses a graduated range of approaches – from assistance to those who want to do the right thing but don't always succeed, through to invoking the full force of the law for wilful illegal behaviour. The aim of the investigation was to secure the best outcome by working with parties, either on a voluntary basis or via a compliance order, to ensure they took the necessary steps regarding decontamination and disposal. A black-and-white, full force of the law response – such as prosecution – is not always considered best practice in addressing non-compliance, especially where those under investigation indicate willingness to comply. The EPA's choice of enforcement action was also guided by consideration of:

- the extent or risk of harm to the public and the environment
- the conduct and compliance history of the person or business
- parties' attitude to compliance

Collecting evidence

EPA investigators sought from each party a list of foams currently in use or storage, by brand name and type. Meetings were held at the various locations, always involving two HSNO-warranted EPA enforcement officers. The EPA sent follow-up letters if it required additional information. Following the meetings, premises and facilities were physically inspected. This included sampling firefighting foam under strict protocols, to prevent cross-contamination, and to protect the integrity of the chain of custody. An "A" and a "B" sample were collected from each selected area or container. "A" samples were sent to AsureQuality, Wellington, for a Certificate of Analysis for the presence of PFOS, PFOA and other PFAS compounds. "B" samples were kept intact in case the company requested a second test. None did.

Sites where PFOS firefighting foam was discovered

Foams containing PFOS were found at six airports; in equipment owned by two companies that service airports; at three sites controlled by a major oil company; in two tug boats; and at a tyre company. Firefighting foam with lower levels of PFOS was also found at a variety of other sites. These lower levels likely resulted from contamination arising from previous use of PFOS foams. In all cases, operators took the EPA's direction, and complied with legal storage and labelling obligations. EPA investigators required 13 sites to flush out and clean equipment and systems to ensure they would not contaminate compliant firefighting foam. Operators also needed to

ensure that residues after rinsing out equipment complied with Resource Management Act and trade waste by-laws.

Stage 1: Airports

Of the 14 airports approached initially, four confirmed they held non-compliant firefighting foam (3M Light Water): Gisborne, Nelson, Palmerston North and Hawke's Bay. EPA investigators physically inspected these airports, and equipment was examined and samples taken. Later testing showed PFOS contamination in foams at three further airports. Two had low levels of contamination in foam in two fire trucks each; the other had a low level of contamination in redundant foam in storage. The airports concerned were Queenstown, New Plymouth and Auckland. Of the remaining 19 airports investigated, Kapiti Coast and the Chatham Islands confirmed they held redundant non-compliant firefighting foam (3M Light Water) in storage.

The EPA physically inspected 10 commercial airports of the 34 identified.

Stage 2: Ports, refineries, bulk fuel storage and petrochemicals sites

Three of 92 sites investigated confirmed they held PFOS firefighting foam. All were controlled by Shell Taranaki Ltd in New Plymouth.

Stage 3: New Zealand-registered ships and shipping companies

Two of the New Zealand-registered ships and shipping companies investigated held non-compliant foam. They were:

- Marine Services Auckland Ltd (on the vessel MV Maui 1)
- Lyttelton Port Company (on the vessel MV Purau)

Compliance and enforcement

Although the EPA investigation identified PFOS firefighting foam at several locations, there was no evidence that anyone had imported it after 2006, when PFOS foams were excluded from the Firefighting Chemicals Group Standard, meaning they could no longer be imported into New Zealand. Those subject to the investigation showed a strong desire to comply with HSNO Act requirements. Sites were proactive in managing the situation and working towards compliance, as the EPA's investigation report shows. In response to our investigation, organisations have taken a range of actions, including seeking export permits to enable environmentally-sound disposal of PFOS foam by high-temperature incineration overseas, and engaging environmental consultants to manage their sites. The EPA served three Compliance Orders early in its investigation, two relating to

Regulatory Update

Nelson Airport Ltd and Nelson Airport Fire Service Ltd. A third Compliance Order was served on a professional services company – Task Protection Services Ltd – that owned and controlled fire trucks, equipment, containers and firefighting foam at Gisborne, Hawke's Bay and Palmerston North Airports. Early in 2019, a further Compliance Order was served on the Lyttelton Port Company. A Compliance Order is a directive instrument that sets out clear actions required to resolve a particular issue. The EPA issued these orders so there would be no misunderstanding of what was required to rectify non-compliance. It is an offence not to comply with such orders. Recipients of the three Compliance Orders relating to airports were required to:

- stop using PFOS firefighting foam (allowances were made for emergency use);
- seek technical advice from EPA-approved experts, and lodge with the EPA a written plan regarding steps to be taken to discontinue use of PFOS foams, and to safely remove, transport and dispose of them; and
- submit action plans to the EPA outlining arrangements for things such as disposing of the foam and associated containers; cleaning firefighting trucks and hangars that held PFOS foam; and storing contaminated waste water.

Developing agreed, final plans was protracted because of the highly technical nature of the work, the need for the parties to retain appropriate expertise, and other logistical challenges. The EPA is monitoring implementation of the plans, and will follow-up as required. The parties involved continue to have legal responsibility for complying with the law, achieved through execution of their respective plans.

Next steps

The EPA investigation is now in a "trust and verify" stage. This means it is visiting entities from a cross-section of sectors that have self-assessed themselves as being compliant. During the EPA visits, firefighting foam is tested to check the integrity of the self-reporting regime.

Review of regulatory instruments

The EPA is working to ensure that the relevant regulatory tools are effective. There needs to be clarity about which firefighting foams are legal for use in New Zealand, and a sound policy basis for the exclusion or restriction of particular foams in the Fire Fighting Chemicals Group Standard. The EPA's work will take account of expanding scientific knowledge about these substances, and recent international

developments in the regulation of firefighting foams. It will include reviewing and amending:

- the Fire Fighting Chemicals Group Standard 2017
- the Hazardous Substance (Storage and Disposal of Persistent Organic Pollutants) Notice 2004

These instruments regulate the use, storage, and disposal of firefighting foams including, in the case of the latter, the old PFOS-containing products. The EPA is intending to issue consultation documents on proposed amendments to this Group Standard and Notice in June 2019.

EPA's greater focus on engagement and compliance

As an organisation, we're working on moving away from our current focus on processing – to spending more time on engaging with our customers and stakeholders, and compliance. Programmes underway aimed at streamlining our processes - for example updating our management of hazardous substances applications, and creating a new chemical management system – will allow us to concentrate more of our efforts on ensuring our environment and people are better protected against harm.

More public information that is easy to access and understand

The EPA have updated its website, with a focus on clarity of navigation and ease of access to information. Our proactive regulator and Open Book initiatives will also make it easier for stakeholders and the public to understand our processes and thinking.

NZ EPA, 4 April 2019

http://www.epa.govt.nz

China Bans Fentanyl, Bowing to U.S. Pressure

2019-04-05

Chinese officials announced recently that an immediate ban on the production and distribution of all "fentanyl-related substances," fulfilling a promise that President Xi Jingping made to President Trump last year following a years-long Department of Justice pressure campaign. Speaking at a press conference in Beijing, officials representing three government agencies announced that they would expand the existing ban on some 25 fentanyl variants to all forms of the drug. Following the Group of 20 summit in Buenos Aires in December, Trump drew attention to China's role in profiting from the sale of fentanyl, which claims tens of thousands of American lives every year. U.S. officials announced after the

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summit that Xi had promised Trump China would crack down on fentanyl production as part of negotiations that led to a halt in the escalating trade war between the two countries. It is outrageous that Poisonous Synthetic Heroin Fentanyl comes pouring into the U.S. Postal System from China. We can, and must, END THIS NOW! The Senate should pass the STOP ACT – and firmly STOP this poison from killing our children and destroying our country. No more delay! U.S. Trade Representative Robert Lighthizer, who leads the ongoing trade negotiations with Beijing, told the Senate last month that he would like China's commitment to curtailing opioid production codified in any final agreement. "It may very well be something that we end up writing into this agreement," Lighthizer told lawmakers in February. "But it clearly is something the president views himself as having a commitment on. And that we are monitoring to see in fact if there are changes." While Chinese officials acknowledged the importance of curtailing fentanyl production, they maintained that China should not be blamed for the devastation wrought by the opioid crisis in the U.S. "We believe that the United States is the main cause of the problem of the abuse of fentanyl in the United States," Liu Yuejin, vice commissioner of China's National Narcotics Control Commission, said at the press conference. While the ban officially went into effect Monday, it remains unclear whether the government will prioritise its enforcement across the thousands of far-flung Chinese chemical factories capable of producing the valuable narcotic.

National Law Review, 1 April 2019

http://www.natlawreview.com

AMERICA

New York passes Manhattan congestion charge and plastic bag ban

2019-04-05

Drivers travelling into the busiest sections of Manhattan will be subject to a congestion charge starting in 2021 and single-use plastic bags will be banned across New York state in less than a year, under a $175.5bn state budget agreement announced on Sunday by the governor, Andrew Cuomo, and legislative leaders. One major issue that did not make it into the spending plan was the legalisation of recreational marijuana. Cuomo and party leaders have said the issue is too complex to rush. It could be handled in the last three months of the legislative session, scheduled to

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end on 19 June. Other agreements in the budget include the closure of up to three state prisons, eliminating cash bail for misdemeanour and nonviolent felony arrests, a permanent 2% cap on local property taxes and another $1bn for public education. "I am proud to announce that together, we got it done," Cuomo said. Lawmakers planned to begin passing budget bills right away during a session that could spill into Monday, when the spending plan for 2019-2020 is due to be in place. Most single-use plastic bags provided by supermarkets and other stores will be banned state-wide starting 1 March 2020. Counties will have the option of charging 5 cents for paper bags, with 2 cents going to local governments and 3 cents to the state environmental protection fund. The Manhattan tolls plan will be the first of its kind in the US. State leaders said a review board will determine the toll amount, exemptions and credits for drivers headed into the central business district. The billions the tolls are expected to raise will go toward fixing New York City's ailing mass transit system. The state budget includes two other revenue sources for the subways: a "mansion tax" on Manhattan homes that sell for $25m or higher and an internet sales tax. The Metropolitan Transportation Authority will be subject to a reorganisation plan and other reforms Cuomo has demanded. Other criminal justice reforms include requiring prosecutors and defence lawyers to share all case information well in advance of trials, and speeding up the time it takes for a case to go to trial. The budget agreement establishes a state commission that will come up with a system for the public financing of legislative and state-wide offices, with up to $100m in taxpayer funds authorized annually for such a system. Cuomo and legislative leaders also agreed to allow three hours of paid time off for New Yorkers to vote on election day and expand voting hours upstate to begin at 6am instead of noon.

The Guardian, 1 April 2019

http://www.guardian.com

Agency provides glimpse of data used to evaluate risks but still redacts some safety information

US EPA releases studies on pigment violet 29

2019-04-05

The United States Environmental Protection Agency has released 24 studies that the agency relied on to evaluate the health risks of pigment violet 29, a colorant used in paints, plastics, and other products. The move comes after Democrats in the US House of Representatives asked the EPA twice this year to make such studies public. Pigment violet 29 is the first of 10 chemicals that the EPA plans to evaluate by the end of this year for risks to human health and the environment under the Toxic Substances

Control Act (TSCA). The EPA released a draft risk assessment of pigment violet 29 in November, concluding that the chemical "does not present an unreasonable risk of injury to human health or the environment under the conditions of use." The agency's release of the 24 studies does not change that determination. Initially, companies that conducted the studies claimed the documents as confidential business information (CBI). Since then, the companies have dropped most of those CBI claims, according to the EPA. Rep. Frank Pallone Jr.(D-NJ), chair of the House Energy and Commerce Committee, and Rep. Paul Tonko (D-NY), welcomed the EPA's release of the studies, calling it "a win for government transparency and the credibility of the TSCA program." Environmental activists, however, raised concerns that the EPA blacked out important safety data in the studies. "At least one key study released today—on reproductive/developmental toxicity—redacts ALL of the study data: 333 of the 430 pages are blacked out," Richard Denison, a lead senior scientist at the Environmental Defence Fund, tweeted on March 22.

Chemical & Engineering News, 28 March 2019

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

California Committee Includes Ultrafine Titanium Dioxide on Its Draft Priority 1 List for PEL Review

2019-04-05

HEAC has posted a draft 2019 Priority 1 List consisting of ten chemical substances

The California Division of Occupational Safety and Health's (Cal/OSHA) Health Effects Advisory Committee (HEAC) for the Development of Permissible Exposure Limits (PEL) will meet on 4 June 2019. According to the meeting agenda, HEAC will discuss the selection of Priority 1 substances for HEAC review. HEAC has posted a draft 2019 Priority 1 List consisting of ten chemical substances. The draft List includes titanium dioxide, ultrafine (<100 nanometres (nm)). According to HEAC, the eight-hour threshold limit value is 0.3 milligrams per cubic metre (mg/m^3). Although California has adopted PELs for a number of airborne contaminants, for titanium dioxide, Table AC-1 in Section 5155 of Title 8 of the California Code of Regulations refers to particulates not otherwise regulated. The respirable fraction for particulates not otherwise regulated is 5.0 mg/m^3. The draft Priority 1 List includes a factor for each substance that is the key consideration used for the ranking. Titanium dioxide, ultrafine (<100 nm) is listed with a factor of 2, "[a] substantial change in the

value of an [occupational exposure limit (OEL)] that could contribute to increased protection of workers if adhered to by employers."

National Law Review, 30 March 2019

http://www.natlawreview.com

EUROPE

EU bans UK's most-used pesticide over health and environment fears

2019-04-05

One of the world's most common pesticides will soon be banned by the European Union after safety officials reported human health and environmental concerns. Chlorothalonil, a fungicide that prevents mildew and mould on crops, is the most used pesticide in the UK, applied to millions of hectares of fields, and is the most popular fungicide in the US. Farmers called the ban "overly precautionary". But EU states voted for a ban after a review by the European Food Safety Authority (EFSA) was unable to exclude the possibility that breakdown products of the chemical cause damage to DNA. EFSA also said "a high risk to amphibians and fish was identified for all representative uses". Recent research further identified chlorothalonil and other fungicides as the strongest factor linked to steep declines in bumblebees. Regulators around the world have falsely assumed it is safe to use pesticides at industrial scales across landscapes, according to a chief scientific adviser to the UK government. Other research in 2017 showed farmers could slash their pesticide use without losses, while a UN report denounced the "myth" that pesticides are necessary to feed the world. A European commission spokeswoman said: "The [chlorothalonil ban] is based on EFSA's scientific assessment which concluded that the approval criteria do not seem to be satisfied for a wide range of reasons. Great concerns are raised in relation to contamination of groundwater by metabolites of the substance." Chlorothalonil has been used across the world since 1964 on barley and wheat, as well as potatoes, peas and beans. The ban will be passed formally in late April or early May and then enter into force three weeks later, the commission spokeswoman said. The link between chlorothalonil and bumblebee losses was revealed in December 2017 in research that surprised scientists. How fungicides harm bees is still being studied, but chlorothalonil in particular is likely to make them more susceptible to the deadly nosema parasite by killing beneficial gut microbes. Matt Shardlow, the chief

Officials say chlorothalonil poses high risk to wildlife and may potentially harm humans

executive of the conservation charity Buglife, said the fact that the link to bumblebee harm had not led to safety tests for wild bees showed the inadequacy of the EU's regulatory system: "Instead the EU process failed to apply the EFSA guidance on assessing risk to bees, so there were no bumblebee safety tests. When will regulators learn the lessons, stop kowtowing to the demands of the pesticide manufacturers and start applying the EFSA guidance that was finalised in 2013?" A widespread loss of pollinating insects in recent decades was revealed by the first national survey in Britain. The analysis of 353 wild bee and hoverfly species found the insects had been lost from a quarter of the places they were found in 1980. However, Chris Hartfield from the UK's National Farmers Union, said chlorothalonil played a vital role in controlling fungal diseases: "We feel the European commission has been overly precautionary in making this decision and has failed to consider the particular importance of this [pesticide] in the control of critical fungal diseases and in managing disease resistance. As a result, we believe sectors of UK agricultural and horticultural production will be put at significant risk."

The Guardian, 30 March 2019

http://www.guardian.com

New draft guideline on phthalates in medical devices

2019-04-05

The EU's Scientific Committee on Health, Environmental and Emerging Risks (SCHEER) invites manufacturers and other stakeholders to comment on the Preliminary Guidelines for benefit-risk assessment of phthalates in medical devices. The deadline is 29 April 2019. The Guideline describes the methodology on how to perform a benefit-risk assessment (BRA) of the presence of phthalates, which are carcinogenic, mutagenic or toxic to reproduction (CMR) and/or have endocrine-disrupting (ED) properties. This includes phthalates in both medical devices and/or parts or materials used therein at percentages above 0.1% by weight (w/w). The methodology of the guidance is suggested to be used for performing BRA of CMR/ED substances in general present in medical devices. Comments must be submitted to SCHEER, and only comments submitted via SCHEER's electronic template will be taken into account. More details are available at: Public consultation on phthalates in medical devices.

DHI Newsletter, 29 March 2019

http://www.dhigroup.com

The EU's Scientific Committee on Health, Environmental and Emerging Risks (SCHEER) invites manufacturers and other stakeholders to comment on the Preliminary Guidelines for benefit-risk assessment of phthalates in medical devices.

Regulatory Update

Mixtures methodology equips EFSA for multiple chemicals

2019-04-04

The European Food Safety Authority (EFSA) has developed a harmonised framework to use across its scientific panels when evaluating the potential "combined effects" of chemical mixtures in food and feed. The approach gives EFSA's scientists the tools to follow a mixtures approach when needed, which complements the current EU regulatory requirements for assessing single substances. People, animals and the environment can be exposed to multiple chemicals from a variety of sources. Understanding how combined chemicals behave is complex and the number of combinations is potentially infinite, so EFSA's Scientific Committee has developed a practical scientific tool for risk assessors that also supports and informs risk managers.

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Milestone in chemical risk assessment

Dr Tobin Robinson, Head of EFSA's Scientific Committee and Emerging Risks Unit, said: "This milestone follows several years of preparatory work by EFSA and our European and international partners. We ensured the guidance remained practical by holding a public consultation in 2018, in which we received over 300 comments, and by engaging with stakeholders during the process. "We are already using some of these principles and tools, for example, on groups of pesticides and groups of contaminants. Now, when we see that a mixtures approach is needed, our harmonised framework puts us in a stronger position to carry this out."

How the guidance works

The approach builds on existing methods and international experience in assessing potential concerns about chemical mixtures. Prof Christer Hogstrand, Chair of the Chemical Mixtures Working Group, said: "Assessing mixtures works similarly to how we tackle single substances. Normally we determine first who is exposed – people, farm animals or wildlife such as birds and bees – and by how much. Then, we estimate the toxicity of the mixture or its individual components. Finally, we quantify the risk by comparing combined exposure and combined toxicity. "Often we add up the doses for common effects to estimate the overall risk. But, sometimes the chemicals 'interact', meaning their toxicity increases or decreases. Interactions like these are uncommon overall but need checking particularly if toxicity increases. Our guidance allows us to do this for every mixture we look at."

Supporting decision-makers

"Ultimately," Dr Robinson said, "this framework is designed to support EU and national risk managers so they can make informed decisions in situations when combined exposure to multiple chemicals needs to be considered."

Low public awareness

An EFSA research study from 2018, also published today, shows that overall in the EU awareness of chemical mixtures among the general public is quite low. EFSA has developed a new interactive multimedia tool to help people understand some of the main issues and concepts, such as "combined exposure" and "combined toxicity". The study presents useful findings for communicators and social researchers on both chemical mixtures and chemicals in food more generally.

EFSA, 25 March 2019

http://www.efsa.europa.eu

Denmark aims for ban on fluorinated chemicals in FCMs

2019-04-05

Denmark may become the first country in the world to ban the use of all organic fluorinated substances in food contact materials (FCM) of cardboard and paper. The Danish Veterinary and Food Administration is currently pursuing the options of a ban. In late 2018, the European Food Safety Authority (EFSA) published a risk assessment of the fluorinated substances PFOS and PFOA, concluding that the substances constitute a much greater health concern than previously estimated. Denmark is concerned that other fluorinated substances may also be more harmful than expected. Instead of waiting for tighter EU regulation, the Danish authorities want to implement a national ban on all organic fluorinated substances in cardboard and paper FCMs.

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DHI Newsletter, 29 March 2019

http://www.dhigroup.com

INTERNATIONAL

ISO Technical Report Helps Assess Nanomaterials' Environmental Impacts

2019-04-05

The American National Standards Institute, administrator of the U.S. Technical Advisory Group for International Standards Organisation Technical Committee 229, has announced the publication of a new ISO Technical Report that can help in assessing the environmental impact of nanomaterials. The 26-page document, ISO TR 21386, Nanotechnologies—Considerations for the measurement of nano-objects and their aggregates and agglomerates (NOAA) in environmental matrices, can be used by industry and academic institutions and by regulators focused on environmental stewardship. ISO TR 21386 was developed by ISO TC 229, Working Group 3, Health, safety and environment. WG 3 is U.S. led, operating under the leadership of Dr. Vladimir Murashov of NIOSH. Dr. Richard Pleus of Intertox is the WG 3 Chair for the ANSI-accredited U.S. TAG to ISO TC 229, with leadership for this project provided by Dr. Raymond David, a member from the American Chemistry Council's Nanotechnology Panel. "This document provides insight into collecting, preparing, and analysing engineered NOAA found in the environment. It helps the investigator understand what influences background levels of naturally occurring nanomaterials, and provides examples of how samples are collected from environmental media," said David. ANSI noted that, among the essential topics pertaining to environmental safety, the report provides useful information on how investigators should respond to several questions or issues that commonly arise:

- What are the background levels of naturally occurring materials of the same or similar composition?
- How do concentrations of naturally occurring materials change over time/geography?
- Can the manufactured NOAA be distinguished from naturally occurring nano-objects?
- What are the instruments that have been used to quantify and characterise NOAA in the environment?
- What are the proper sample preparation methods and do these methods vary with the nanomaterial of interest, or do they vary with the medium?

ANSI noted that, among the essential topics pertaining to environmental safety, the Technical Report provides useful information on how investigators should respond to several questions or issues that commonly arise.

Regulatory Update

ANSI administers the U.S. TAG for ISO TC 229, which was established in June 2005 to progress standardisation in nanotechnology.

Occupational Health & Safety News, 27 March 2019

http://www.ohsonline.com

REACH Update

Companies recommended to transfer registrations before the UK's withdrawal

2019-04-04

The European Chemicals Agency (ECHA) continues to recommend companies to prepare for the UK withdrawal without a transition period, now expected to take effect on 13 April 2019. Companies are reminded to initiate the transfer of their registrations and other assets through ECHA's IT tools before the UK withdrawal takes effect (on 13 April 2019, at 00:00 hours CET), and not to leave these transactions to the last moment. The number of registrations for which a transfer was initiated from a UK-based registrant to an EU-27 based company is increasing, with the cumulative figure exceeding 4 800 by the end of March out of approximately 12 000 UK registrations in total. Companies can still benefit from the advice and practical instructions on ECHA's website to minimise the impact of the UK's withdrawal on their business, concerning REACH, CLP, PIC and the Biocidal Products Regulation. Further information is available at:

- UK's withdrawal from the EU
- Advice to companies
- Step-by-step guide on transferring UK registrations

ECHA, 3 April 2019

http://echa.europa.eu

The European Chemicals Agency (ECHA) continues to recommend companies to prepare for the UK withdrawal without a transition period, now expected to take effect on 13 April 2019.

New submission date for restriction proposals on lead chromates, calcium cyanamide and organophosphate flame retardants

2019-04-04

The European Chemicals Agency (ECHA) will submit restriction dossiers on 19 July 2019 for the following substances:

- calcium cyanamide (EC 205-861-8, CAS 156-62-7);
- lead chromate; lead sulfochromate yellow (C.I. Pigment Yellow 34); lead chromate molybdate sulphate red (C.I. Pigment Red 104) (EC -, CAS -); and
- tris(2-chloroethyl) phosphate (TCEP); tris(2-chloro-1-methylethyl) phosphate (TCPP); Reaction mass of tris(2-chloropropyl) phosphate and tris(2-chloro-1-methylethyl) phosphate and Phosphoric acid, bis(2-chloro-1-methylethyl) 2-chloropropyl ester and Phosphoric acid, 2-chloro-1-methylethyl bis(2-chloropropyl) ester (TCPP); Reaction

products of phosphoryl trichloride and methyloxirane (TCPP); tris[2-chloro-1-(chloromethyl)ethyl] phosphate (TDCP) (EC -, CAS -).

Registry of restriction intentions

ECHA News, 3 April 2019

http://echa.europa.eu

Tips for improving your registration dossier

2019-04-04

Over the next months, the European Chemicals Agency (ECHA) will be publishing tips in the Weekly based on the agency's evaluation work. To get started on improving your dossier, have a look at ECHA's general recommendations to registrants: General recommendations

ECHA News, 3 April 2019

http://echa.europa.eu

Public consultations on harmonised classification and labelling

2019-04-04

The European Chemicals Agency (ECHA) is seeking comments on the harmonised classification and labelling proposals for:

- 2,4,6-tri-tert-butylphenol (EC 211-989-5, CAS 732-26-3); and
- 1,4-dimethylnaphthalene (EC 209-335-9, CAS 571-58-4).

Comments are invited on the relevant hazard classes for each substance. The deadline for comments is 31 May 2019. Further information is available at: Give comments

ECHA News, 3 April 2019

http://echa.europa.eu

Over the next months, the European Chemicals Agency (ECHA) will be publishing tips in the Weekly based on the agency's evaluation work.

Targeted consultation on the harmonised classification and labelling of diflufenican (ISO)

2019-04-04

The proposal for the harmonised classification and labelling of diflufenican (ISO); N-(2,4-difluorophenyl)-2-[3-(trifluoromethyl)phenoxy]-3-pyridinecarboxamide (EC 617-446-2, CAS 83164-33-4) was submitted by United Kingdom and was subject to a public consultation which

ended on 7 December 2018. After the public consultation, one study report containing additional information on the hazard to the aquatic environment was submitted to ECHA and EFSA. All interested parties are invited to submit comments on the study report through the commenting webform by 15 April 2019. The comments will be published on ECHA's website. Further information is available at: Give comments

ECHA News, 3 April 2019

http://echa.europa.eu

New intention to harmonise classification and labelling

2019-04-04

The European Chemicals Agency (ECHA) has received a new intention to harmonise classification and labelling. The intention was received for benalaxyl (ISO) (EC 275-728-7, CAS 71626-11-4). Further information is available at: Registry of CLH intentions until outcome

ECHA News, 3 April 2019

http://echa.europa.eu

The European Chemicals Agency (ECHA) has received a new intention to harmonise classification and labelling.

New In brief on information requirements for poison centres notifications

2019-04-04

The In brief provides an overview of the information required for notifying hazardous mixtures according to Annex VIII to the CLP Regulation. The publication is currently available in English on ECHA's Poison Centres website. Further information is available at: In brief - Information requirements for poison centres notifications

ECHA News, 3 April 2019

http://echa.europa.eu

R4BP 3: Update on reallocation of UK biocides cases

2019-04-04

Changes in evaluating authorities have been implemented in the biocides submission tool R4BP 3. The European Commission has assigned the active substance approval cases handled by the UK to evaluating competent authorities in other Member States, through an amendment to the Review Programme Regulation. Even though the UK's withdrawal from the EU has

been postponed, the changes needed to be implemented, as the adopted amendment applies from 30 March 2019. Further information is available at: Amending regulation to the Review Programme

ECHA News, 3 April 2019

http://echa.europa.eu

Janet's Corner

CHEMWATCH

Silvers walks up to gold in a bar

2019-04-05

Hazard Alert

Ammonia

2012-11-06

Ammonia or azane is a compound of nitrogen and hydrogen with the formula NH_3. [1] It is a colourless highly irritating gas with a sharp suffocating odour. Ammonia dissolves easily in water to form ammonium hydroxide solution, which can cause irritation and burns. Ammonia gas is easily compressed and forms a clear, colourless liquid under pressure. It is not highly flammable, but containers of ammonia may explode when exposed to high heat. [2] Ammonia gas can be dissolved in water. This kind of ammonia is called liquid ammonia or aqueous ammonia. Once exposed to open air, liquid ammonia quickly turns into a gas. Ammonia occurs naturally and is produced by human activity. It is an important source of nitrogen, which is needed by plants and animals. Bacteria found in the intestines can produce ammonia. [3]

USES

Ammonia is used widely in many areas. It is present in commonly used household and industrial cleaners, bleaching agents and disinfectants. It is used in the preparation of synthetic fibres (e.g. nylons), plastics and explosives, resins, human and veterinary medicines, fertilisers, chemical compounds, fuel cells, rocket fuel, dyes, metal treating operations, refrigeration, and in the petroleum industry.

Ammonia or azane is a compound of nitrogen and hydrogen with the formula NH3.

SOURCES OF EMISSION [4]

- Industry sources: Ammonia is released during intensive livestock production, and from humans and pets. Other sources of ammonia emission include the manufacture of basic chemicals, metals, leather products, cement, lime, plaster and concrete products, glass products, ceramics, beverages, cars and car parts, textile products and paper and paper products. In addition, ammonia is produced from mining, electricity supply and petroleum refining activities.
- Diffuse sources: Human and pet metabolic processes, cigarette smoke and household cleaners are sources of ammonia. Burning, through controlled fires or wildfires, or of other fuels also results in ammonia emissions. Indoor residential levels of ammonia can be significantly higher than outdoor levels.
- Natural sources: Ammonia is found in the environment, in the air, soil and water, in plants and animals. It is formed naturally by the decomposition of urine and manure. It is a source of nitrogen, which is

needed by plants and animals. It has also been observed in outer space and galactic dust clouds.

- Transport sources: Motor vehicles, through their exhaust, produce ammonia.
- Consumer products: Many cleaning products, bleaching products and disinfectants contain ammonia.

SOURCES OF EXPOSURE & ROUTES OF EXPOSURE [5]

Sources of Exposure

- Ammonia is found naturally in the environment. The general population is most likely to be exposed through inhalation of contaminated indoor air, although exposure can also occur through ingestion of contaminated food or water, or through dermal contact.
- In indoor air, exposure may occur through use of household products such as window cleaners, floor waxes and smelling salts.
- In outdoor air, exposure may occur as a result of gas leaks and spills at production plants and storage facilities or from pipelines, tank trucks, railcars, ships and barges that transport ammonia.
- Ammonia is released into the atmosphere naturally by decaying organic matter, animal excreta and volcanic eruptions. It is released anthropogenically through fertiliser usage, spills or leaks, and loss from wastewater effluents.
- Farmers, cattle ranchers and individuals who raise livestock and/or poultry may be exposed to ammonia from decaying manure.
- Farmers may also be exposed to ammonia during the application of fertilisers on fields.

Routes of Exposure

- Inhalation – Predominant route of exposure for general population
- Oral – Minor route of exposure for the general population through ingestion of contaminated drinking water.
- Dermal – Minor route of exposure through dermal contact with cleaning products containing ammonia.

HEALTH EFFECTS [4,5]

Exposure to high levels of ammonia can cause irritation and serious burns on the skin, and in the mouth, throat (laryngitis), lungs (pulmonary oedema) and eyes (conjunctivitis). Exposure at very high levels of

ammonia can lead to death. Swallowing concentrated solutions of ammonia can cause burns in the mouth, throat and stomach. Splashing ammonia into the eyes can cause burns and blindness. Individuals that may be more sensitive to ammonia are those with reduced liver function, corneal disease, glaucoma or respiratory diseases (e.g. asthmatics). Ammonia has not been classified for carcinogenic effects by the DHHS, or IARC or EPA.

SAFETY [6]

First Aid Measures

- Inhalation: Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.
- Ingestion: If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. Get medical attention immediately.
- Skin Contact: Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention immediately. Wash clothing before reuse. Thoroughly clean shoes before reuse.
- Eye Contact: Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.
- Note to Physician: DO NOT induce emesis, perform gastric lavage or attempt neutralisation after ingestion. Dilution with milk or water may be of benefit. Endoscopic evaluation may be required.

Fire Fighting Measures

- Explosion: Gives off flammable vapours. Vapours may form explosive mixture with air. Closed containers exposed to heat may explode.
- Fire Extinguishing Media: Use any means suitable for extinguishing surrounding fire. Water spray may be used to keep fire-exposed containers cool. Do not allow water runoff to enter sewers or waterways.
- Special Information: In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full face-piece operated in the pressure demand or other positive pressure mode.

Exposure Controls & Personal Protection

- Ventilation System: A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area
- Personal Respirators (NIOSH Approved): If the exposure limit is exceeded, a full face piece respirator with an ammonia/methylamine cartridge may be worn up to 50 times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-face piece positive-pressure, air-supplied respirator.
- WARNING: Air purifying respirators do not protect workers in oxygen-deficient atmospheres.
- Skin Protection: Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.
- Eye Protection: Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

REGULATION [3,4,6]

Exposure Limits

United States

- The Food and Drug Administration (FDA): Some restrictions have been placed on levels of ammonium salts allowable in processed foods. FDA states that the levels of ammonia and ammonium compounds normally found in food do not pose a health risk.
- The Occupational Safety and Health Administration (OSHA) has set an acceptable eight-hour exposure limit at 25 parts of ammonia per one million parts of air (ppm) and a short-term (15 minutes) exposure level at 35 ppm
- American Conference of Industrial Hygienists (ACGIH): Threshold Limit Value (TLV) 25 ppm (TWA), 35 ppm (STEL).

Australia

- Safe Work Australia: Currently, the eight-hour time weighted average (TWA) exposure limit is 17 milligrams of ammonia per cubic metre of air, and the 15-minute short-term exposure limit (STEL) is 24 milligrams of ammonia per cubic metre of air.
- Drinking water guidelines: In 2004, the National Health and Medical Research Council (NHMRC) and the National Resource Management Ministerial Council (NRMMC) established the following guideline for acceptable water quality: Maximum of 0.5 milligrams per litre of water. This is based on aesthetic consider.

REFERENCES

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4. http://www.npi.gov.au/substances/ammonia/index.html
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Gossip

BU researchers develop 'acoustic metamaterial' that cancels sound

2019-03-20

Boston University researchers, Xin Zhang, a professor at the College of Engineering, and Reza Ghaffarivardavagh, a Ph.D. student in the Department of Mechanical Engineering, released a paper in Physical Review B demonstrating it's possible to silence noise using an open, ringlike structure, created to mathematically perfect specifications, for cutting out sounds while maintaining airflow. "Today's sound barriers are literally thick heavy walls," says Ghaffarivardavagh. Although noise-mitigating barricades, called sound baffles, can help drown out the whoosh of rush hour traffic or contain the symphony of music within concert hall walls, they are a clunky approach not well suited to situations where airflow is also critical. Imagine barricading a jet engine's exhaust vent--the plane would never leave the ground. Instead, workers on the tarmac wear earplugs to protect their hearing from the deafening roar. Ghaffarivardavagh and Zhang let mathematics--a shared passion that has buoyed both of their engineering careers and made them well-suited research partners--guide them toward a workable design for what the acoustic metamaterial would look like. They calculated the dimensions and specifications that the metamaterial would need to have in order to interfere with the transmitted sound waves, preventing sound--but not air--from being radiated through the open structure. The basic premise is that the metamaterial needs to be shaped in such a way that it sends incoming sounds back to where they came from, they say. As a test case, they decided to create a structure that could silence sound from a loudspeaker. Based on their calculations, they modelled the physical dimensions that would most effectively silence noises. Bringing those models to life, they used 3D printing to materialize an open, noise-cancelling structure made of plastic. Trying it out in the lab, the researchers sealed the loudspeaker into one end of a PVC pipe. On the other end, the tailor-made acoustic metamaterial was fastened into the opening. With the hit of the play button, the experimental loudspeaker set-up came oh-so-quietly to life in the lab. Standing in the room, based on your sense of hearing alone, you'd never know that the loudspeaker was blasting an irritatingly high-pitched note. If, however, you peered into the PVC pipe, you would see the loudspeaker's subwoofers thrumming away. The metamaterial, ringing around the internal perimeter of the pipe's mouth, worked like a mute button incarnate until the moment when Ghaffarivardavagh reached

Boston University mechanical engineers create synthetic, sound-silencing structure that blocks 94 percent of sounds

down and pulled it free. The lab suddenly echoed with the screeching of the loudspeaker's tune. "The moment we first placed and removed the silencer...was literally night and day," says Jacob Nikolajczyk, who in addition to being a study co-author and former undergraduate researcher in Zhang's lab is a passionate vocal performer. "We had been seeing these sorts of results in our computer modelling for months--but it is one thing to see modelled sound pressure levels on a computer, and another to hear its impact yourself." By comparing sound levels with and without the metamaterial fastened in place, the team found that they could silence nearly all--94 percent to be exact--of the noise, making the sounds emanating from the loudspeaker imperceptible to the human ear. Now that their prototype has proved so effective, the researchers have some big ideas about how their acoustic-silencing metamaterial could go to work making the real-world quieter. "Drones are a very hot topic," Zhang says. Companies like Amazon are interested in using drones to deliver goods, she says, and "people are complaining about the potential noise." "The culprit is the upward-moving fan motion," Ghaffarivardavagh says. "If we can put sound-silencing open structures beneath the drone fans, we can cancel out the sound radiating toward the ground." Closer to home--or the office--fans and HVAC systems could benefit from acoustic metamaterials that render them silent yet still enable hot or cold air to be circulated unencumbered throughout a building. Ghaffarivardavagh and Zhang also point to the unsightliness of the sound barriers used today to reduce noise pollution from traffic and see room for an aesthetic upgrade. "Our structure is super lightweight, open, and beautiful. Each piece could be used as a tile or brick to scale up and build a sound-cancelling, permeable wall," they say. The shape of acoustic-silencing metamaterials, based on their method, is also completely customizable, Ghaffarivardavagh says. The outer part doesn't need to be a round ring shape in order to function. "We can design the outer shape as a cube or hexagon, anything really," he says. "When we want to create a wall, we will go to a hexagonal shape" that can fit together like an open-air honeycomb structure. Such walls could help contain many types of noises. Even those from the intense vibrations of an MRI machine, Zhang says. According to Stephan Anderson, a professor of radiology at BU School of Medicine and a co-author of the study, the acoustic metamaterial could potentially be scaled "to fit inside the central bore of an MRI machine," shielding patients from the sound during the imaging process. Zhang says the possibilities are endless, since the noise mitigation method can be customized to suit nearly any environment: "The idea is that we can now mathematically design an object that can block the sounds of anything," she says.

Gossip

EurekAlert, 7 March 2019

http://www.eurekalert.org

Potential new treatment for heart attack

2019-03-20

Scientists have found a potential new drug for treating the heart damage caused by a heart attack by targeting the way the heart reacts to stress, according to new research published in the journal, Cell Stem Cell and part-funded by the British Heart Foundation (BHF). The research team used stem cells to grow heart tissue and mimic a 'heart attack in a dish', and were able to block the chemical signals within heart muscle that lead to cell death and heart damage. The team, led by BHF Professor Michael Schneider at the National Heart and Lung Institute, Imperial College London, are the first to discover that a protein called MAP4K4 plays a central role in how heart muscle cells die off as a response to the stress of a heart attack. They have managed to develop a potential drug that targets this protein and can minimise damage after a heart attack by 60 per cent, in mice. A heart attack happens when a blood clot blocks one of the main coronary arteries, the blood vessels supplying the heart muscle. The heart is starved of oxygen and nutrients and the muscle produces stress signals that ultimately cause heart cells to die. This means that the heart can't pump effectively and this can lead to heart failure. Heart failure is a debilitating condition that makes everyday tasks like climbing stairs, or even getting dressed, exhausting. Due in large part to research funded by the BHF, more people than ever before are surviving their heart attack after receiving treatments like stents and clot-busting drugs, but this means that the number of people living with heart failure has risen considerably. There are estimated to be over 900,000 people living with heart failure in the UK. BHF Professor Michael Schneider and his team are working to develop drugs that could be given in the first few hours following a heart attack to minimise heart muscle death caused by the stress signals. These stress signals actually increase dramatically when the blood supply is restored so, although it is vital to resupply the heart with oxygen and nutrients by reopening the blocked coronary artery, additional treatments to counteract any 'reperfusion injury' have been sought for decades. It's hoped the treatment would be developed

Prospective drug found by testing in human heart muscle grown from stem cells

into an injection that could be given as someone was being prepared to receive balloon angioplasty to open up the blocked coronary artery that caused their heart attack. The treatment is also possibly important for towns and countries where there is limited access to rapid angioplasty. The researchers made their discovery by studying heart samples from people with heart failure and then showed that MAP4K4 is activated in mice after a heart attack, and in heart cells and heart tissue subjected to stress chemicals in the laboratory. They found that if you raise the levels of MAP4K4, heart cells are made more sensitive to stress signals. If you block MAP4K4, the cells are protected and that is what their designed drug can achieve. To mimic what might happen in a clinical setting, the mice were given the drug one hour after the blood flow to their hearts was restored. This showed that the drug could reduce heart damage in mice by around 60 per cent. Notoriously, potential treatments from prior research into protection from heart muscle death have not proven effective in large clinical trials, but the team believe targeting this new protein, and testing their results in human heart tissue grown from stem cells before moving to trials in heart attack patients, could be the key to success in this area. These successes have led to a family of potential new drugs being developed for heart attack, with the next steps including rigorous safety testing and a clinical trial, which could start as early as 2021-22. This research was funded by the British Heart Foundation, the Medical Research Council and Wellcome. BHF Professor Michael Schneider who led the research at the BHF Centre of Regenerative Medicine said: "There are no existing therapies that directly address the problem of muscle cell death and this would be a revolution in the treatment of heart attacks. "One reason why many heart drugs have failed in clinical trials may be that they have not been tested in human cells before the clinic. Using both human cells and animals allows us to be more confident about the molecules we take forward." Professor Metin Avkiran, Associate Medical Director at the British Heart Foundation, which part-funded the research, said: "Coronary heart disease is the major cause of heart attacks and it kills 180 people in the UK each day. Finding a drug that could limit the death of heart muscle during and after a heart attack, and stop the decline towards heart failure, has been a target of research for decades. But, despite a number of promising candidates in the past, we still have no drugs that can do this in routine clinical use. "A unique strength of this study is their extensive testing of the drug in heart muscle cells grown from human stem cells. But further research is needed to refine and test drugs that can target MAP4K4 before we'll see them given to people who've had a heart attack." This research was funded by the British Heart Foundation and Wellcome Trust. Cambridge medicinal chemistry firm Domainex partnered for the design and manufacture of

the drugs tested. Trevor Perrior from Domainex, who made the family of potential drugs said: "Our team were thrilled to work on this exciting new target discovered by Michael's team. There were several challenges that we had to solve in order to invent a series of potential drug compounds that were potent, selective, and - importantly - suitable for dosing intravenously, and it was enormously gratifying when we were successful and they worked just as Michael had predicted. We look forward to at least one of these compounds progressing towards the clinic for the benefit of patients."

EurekAlert, 7 March 2019

http://www.eurekalert.org

New reactor-liner alloy material offers strength, resilience

2019-03-20

A new tungsten-based alloy developed at Los Alamos National Laboratory can withstand unprecedented amounts of radiation without damage. Essential for extreme irradiation environments such as the interiors of magnetic fusion reactors, previously explored materials have thus far been hobbled by weakness against fracture, but this new alloy seems to defeat that problem. "This material showed outstanding radiation resistance when compared to pure nanocrystalline tungsten materials and other conventional alloys," said Osman El Atwani, the lead author of the paper and the principal investigator of the "Radiation Effects and Plasma Material Interactions in Tungsten Based Materials" project at Los Alamos. "Our investigations of the material mechanical properties under different stress states and response of the material under plasma exposure are ongoing." "It seems that we have developed a material with unprecedented radiation resistance," said principal investigator Enrique Martinez Saez, a co-author of the paper at Los Alamos. "We have never seen before a material that can withstand the level of radiation damage that we have observed for this high-entropy [four or more principal elements] alloy. It seems to retain outstanding mechanical properties after irradiation, as opposed to traditional counterparts, in which the mechanical properties degrade easily under irradiation." Arun Devaraj, a materials scientist and project collaborator at Pacific Northwest National Laboratory, noted, "Atom probe tomography revealed an interesting atomic level layering of different

elements in these alloys, which then changed to nanoclusters when subjected to radiation, helping us to better understand why this unique alloy is highly radiation tolerant." The material, created as a thin film, is a quaternary nanocrystalline tungsten-tantalum-vanadium-chromium alloy that has been characterised under extreme thermal conditions and after irradiation. "We haven't yet tested it in high-corrosion environments," Martinez Saez said, "but I anticipate it should perform well there also. And if it is ductile, as expected, it could also be used as turbine material since it is a refractory, high-melting-point material." Described in a paper in Science Advances, the project was a multi-institutional effort, involving researchers and facilities of Los Alamos National Laboratory, Argonne National Laboratory, Pacific Northwest National Laboratory, Warsaw University of Technology, Poland, and the United Kingdom Atomic Energy Authority.

Phys.org, 5 March 2019

http://phys.org

Light from an exotic crystal semiconductor could lead to better solar cells

2019-03-20

Rutgers-led team finds a new way to control light emitted by a hybrid crystal

Scientists have found a new way to control light emitted by exotic crystal semiconductors, which could lead to more efficient solar cells and other advances in electronics, according to a Rutgers-led study in the journal Materials Today. Their discovery involves crystals called hybrid perovskites, which consist of interlocking organic and inorganic materials, and they have shown great promise for use in solar cells. The finding could also lead to novel electronic displays, sensors and other devices activated by light and bring increased efficiency at a lower cost to manufacturing of optoelectronics, which harness light. The Rutgers-led team found a new way to control light (known as photoluminescence) emitted when perovskites are excited by a laser. The intensity of light emitted by a hybrid perovskite crystal can be increased by up to 100 times simply by adjusting voltage applied to an electrode on the crystal surface. "To the best of our knowledge, this is the first time that the photoluminescence of a material has been reversibly controlled to such a wide degree

with voltage," said senior author Vitaly Podzorov, a professor in the Department of Physics and Astronomy in the School of Arts and Sciences at Rutgers University-New Brunswick. "Previously, to change the intensity of photoluminescence, you had to change the temperature or apply enormous pressure to a crystal, which was cumbersome and costly. We can do it simply within a small electronic device at room temperature." Semiconductors like these perovskites have properties that lie between those of the metals that conduct electricity and non-conducting insulators. Their conductivity can be tuned in a very wide range, making them indispensable for all modern electronics. "All the wonderful modern electronic gadgets and technologies we enjoy today, be it a smartphone, a memory stick, powerful telecommunications and the internet, high-resolution cameras or supercomputers, have become possible largely due to the decades of painstaking research in semiconductor physics," Podzorov said. Understanding photoluminescence is important for designing devices that control, generate or detect light, including solar cells, LED lights and light sensors. The scientists discovered that defects in crystals reduce the emission of light and applying voltage restores the intensity of photoluminescence. Hybrid perovskites are more efficient and much easier and cheaper to make than standard commercial silicon-based solar cells, and the study could help lead to their widespread use, Podzorov said. An important next step would be to investigate different types of perovskite materials, which may lead to better and more efficient materials in which photoluminescence can be controlled in a wider range of intensities or with smaller voltage, he said.

EurekAlert, 6 March 2019

http://www.eurekalert.org

A self-healing composite

2019-03-20

Researchers from EPFL's Laboratory for Processing of Advanced Composites have developed a material that can easily heal after being damaged. This cutting-edge composite could be used in aircraft, wind turbines, cars and sports equipment. When a wind turbine blade or an airplane is hit by something, the damaged part has to be either replaced or patched with resin. Replacing the part is expensive, while repairing it with resin can make it heavier and change its properties. But now,

thanks to a new, patented technology, researchers at EPFL have found a way to quickly and easily repair cracks in composite structures. "With our technology, a repair agent is incorporated in the composite material," says Amaël Cohades, a researcher at EPFL's Laboratory for Processing of Advanced Composites (LPAC). Cracks in the resin can be repaired on site in little time by simply heating the material to 150°C. The heating process activates the repair agent, and the damaged part quickly heals, without any change to the original properties. This new-to-the-market technology can be applied to all sorts of structures, extending their lifespan at least threefold. The material's properties and initial crack resistance are the same as those of traditional composites. What's more, the technology is compatible with current manufacturing processes, so production facilities do not need to be retooled. This technology could be particularly useful for wind turbines and storage tanks. "The cost of maintaining the world's wind turbines alone is estimated at 13 billion Swiss francs in 2020," says Cohades. He says the technology could also be applied to "many parts that we don't bother to repair at present, like bikes and car bumpers." One limitation is that the material doesn't heal if the impact breaks the fibres. But since the resin is always damaged first, this heat-based self-healing system would still work in the majority of cases.

Phys.org, 6 March 2019

http://phys.org

Wood can now be processed into a super-material with extraordinary properties – and a wood-based, climate-saving economy is just what the planet needs

Our wooden future: making cars, skyscrapers and even lasers from wood

2019-03-20

Did you hear about the wooden car, with wooden wheels, a wooden chassis and a wooden engine? It wooden go. Or would it? In a few years' time, when people really are driving wooden cars, that joke will be headed for the junkyard. "Wood could be used in cars," says materials scientist Liangbing Hu at the University of Maryland. He recently received a massive grant to build cars out of high-tech wood, and he doesn't have the road to himself. Engineers in Japan are also working on a wooden concept car due to be unveiled at the Tokyo Olympics in 2020. But cars are just the green shoots of a growing wood revolution. In materials science labs and design

studios around the world, people are working on an entire civilisation built from wood. In this future, steel, concrete, plastics and even electronics have been felled by wood. Wooden cars ply streets towered over by wooden skyscrapers with wooden windows. Wooden aeroplanes fly overhead, powered by wooden batteries. People wear wooden clothes and use mobile phones made from wood. It may sound like toy town, but it is deadly serious. The stages of human civilisation have always been crudely measured by material progress. The Stone Age gave way to the Bronze Age and then the Iron Age. Today, we live in the hydrocarbon age, fuelled by coal, oil and gas. They supply our energy needs and make possible the materials that define our civilisation: steel, concrete and plastic. But this has to end. To avoid trashing the planet with plastic waste and carbon dioxide, we will have to stop using hydrocarbons, and soon. The way to get there could be to create a circular economy built on sustainable materials, especially wood. Wood has long been part of the material mix, of course, used in buildings, tools and for energy. But in the not-too-distant future, it may be the dominant material. "Everything that is made from fossil-based materials today can be made from a tree tomorrow," says Åsa Ek, chief executive of Finnish-owned materials company Cellutech. But not wood as you know it. Sure, raw wood has many useful properties: it is strong, yet light and flexible. It is beautiful and economical. It literally grows on trees. But it also has some serious disadvantages that caused it to be overtaken by other materials. Its properties are unpredictable. It burns, cracks and rots. It is bulky and non-transparent. But the same can be said of other raw materials. Crude oil, iron ore and the basic ingredients for concrete are of little use as they are. To unlock their potential, they have to be processed. The same is true of wood – we just have to discover how, and then build the infrastructure to do it. When we have cracked that, we will enter the Wood Age. The first place where wood is likely to replace unsustainable materials is in buildings. It already has a long history as a construction material, but its disadvantages mean that new buildings are mostly made from steel and concrete. These are great for construction but appalling for the environment. Steel production accounts for about 3 per cent of the world's greenhouse gas emissions and concrete about 5 per cent. That is not sustainable. According to the recent report from the Intergovernmental Panel on Climate Change on keeping warming below 1.5°C, the drastic emissions cuts required mean building construction has to be carbon neutral by 2020. That almost certainly means radically cutting down on steel and concrete. Luckily, this is already starting to happen thanks to a wood-based material called cross-laminated timber (CLT), which can replace both. CLT is made by gluing sheets of wood together – usually from Norway spruce or beech trees – to create large, flat slabs.

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These can be stacked to make buildings like giant Jenga blocks. Unlike Jenga, there is no risk of this stuff falling down.

Skyscrapers of wood

CLT is wood turned up to 11: it is pimped up timber. "It's an engineered material, not like a plank you get from a hardware store," says Darshil Shah, an engineer at the University of Cambridge's Centre for Natural Material Innovation. Unlike raw wood, it has predictable and reliable material properties, created by layering the grain of each sheet at right angles to the previous one. That imparts a steely strength and also makes CLT long-lived and surprisingly fire-resistant. CLT was invented in the 1990s, but is growing in popularity thanks to an ongoing race to build the world's tallest wooden skyscraper. The current leader is an 18-storey student residence in Vancouver, Canada, which was finished in 2017. This year it will be overtaken by a block in Brumunddal, Norway. And more are on the drawing board, including an 80-storey, 300-metre tower planted right in the middle of London's Barbican Centre. Shah says the skyscrapers are raising awareness, but the real action is in mid-rise buildings. An eight-storey wooden building can be prefabricated off-site and put together in a few days. The material can be grown in sustainably managed forests and, given how many of those there are, it is as if the wood for a single apartment takes just 7 seconds to grow. And while CLT costs a bit more than steel and concrete, it makes construction quicker. Rather than spewing carbon dioxide, it locks carbon away for the lifetime of the building, typically 60 to 70 years. This carbon storage can be a small but useful brake on climate change. According to a 2017 report on greenhouse gas removal by the Royal Society and the UK Royal Academy of Engineering, switching to timber in construction could instantly wipe a billion tonnes off the world's annual carbon emissions. That is 2.3 per cent of the total – not a huge amount, but in a world where we have to do everything, immediately, it isn't to be sniffed at. And as cities grow, the potential of CLT does too. Around 65 per cent of the urban infrastructure that will be needed in 2030 has yet to be built. If it is constructed with concrete and steel, we have little chance of keeping temperatures down. CLT does not eliminate the old materials completely, but reduces them by up to 80 per cent. "We still use concrete for foundations," say Shah. "But a wood building is about a third of the weight of a steel and concrete building. That means we require less deep foundations so it reduces the amount tremendously." Wood also improves a building's insulation, further cutting its carbon footprint. In the not-too-distant future, wood could even be used in place of glass in windows. A few years ago, scientists at the

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Wallenberg Wood Science Centre in Stockholm, Sweden, invented a way to extract the pigments from wood. The result was a transparent material that can be used like glass, but with better insulating properties – another small step toward a zero-carbon future. If all this conjures up images of soaring wooden structures resembling the interior of a Scandinavian design studio, think again. The buildings are usually clad, so the wooden structure is hidden. That is a shame, says Shah. "People don't realise that they are timber. Public perception is one of the key things that needs to be addressed." I went to have a look at 24 Murray Grove, a nine-storey block of flats in London. When it was completed in 2009, it was the tallest timber building in the world. I also dropped in on nearby Dalston Lane, which was completed last year and is the largest CLT building in the world measured by volume. From the outside, you would never know either was built from wood. Nonetheless, says Shah, for mid-rise buildings "CLT might be industry standard in five to 10 years". Even then, there is more to be done to optimise CLT's carbon footprint. The glue, which comprises about 5 per cent of the final material, is made from petrochemicals. The wood has to be dried in kilns that are often powered by fossil fuels. The drying process consumes about 90 per cent of the energy required to make CLT, says Shah. The answer to both may be… yet more wood. Wood is already used as a sustainable biofuel, and scaling up that industry plays a major role in all scenarios that keep global warming to manageable levels. It is considered to be a carbon-neutral biofuel, as long as trees are replanted. Wood is also being developed as a source of raw materials to replace the oil-based compounds that dominate today's chemicals market. This is where wood as we know it starts to disappear, and its integral components come to the fore.

Wood is a complex mixture of organic chemicals. About 40 per cent of it is nanocellulose, bundles of long, strong fibres that are like a natural version of Kevlar, the synthetic material used in bulletproof vests. "It's a very strong fibre with excellent mechanical properties," says Lars Berglund, director of the Wallenberg Wood Science Centre. A further 30 per cent is lignin, a rich mix of organic compounds not dissimilar to crude oil. The rest is a starch-like substance called hemicellulose. These three components work together to create wood's material properties, and they can all be extracted and processed into useful – and valuable – compounds.

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"Wood can be turned into a transparent material that can be used like glass"

Petrochemicals are another gigantic environmental problem. According to the International Energy Agency, their production consumes about as much energy as steel and cement combined and requires a lot of materials derived from oil. Demand for these by this industry is soaring.

"We would like to replace these fossil resources with trees," says Berglund. To that end, he and his colleagues are working to create a wood refinery that, like an oil refinery, takes crude wood and processes it into valuable end products. At present, it is little more than a pilot plant made from lab equipment, but in the future, it could develop into a massive – and massively sustainable – "arbo-chemicals" industry. Applications for the end products of this are coming fast. The most advanced are based on nanocellulose. "It's really catching on," says Berglund. "You can make all sorts of exciting materials out of it." Nanocellulose is already used as a petrochemical substitute in paints, glues, cosmetics, nappies, packaging and electronics. The car industry is exploring it as a replacement for glass fibres in bodywork. Many more uses are likely to follow. Around 5000 scientific papers are published each year on new applications for nanocellulose, says Berglund – including for clothing. Next in the queue is lignin. "Lignin is the coming revolution," says Berglund. Today it is a waste product from wood pulp and paper processing, with most of it getting burned for energy or used as an additive in concrete. But these are a waste, says Berglund. "Lignins are valuable chemicals. There's a lot of activity in chemical companies trying to use it to replace petroleum-based products. The most exciting development is in coatings, adhesives and resins."

<u>It can even replace plastic</u>

The laggard is hemicellulose. This starchy substance is hard to process, says Berglund, but progress is being made. The ultimate aim is to use it to replace the ultimate petrochemical product, plastic. Nothing epitomises the petrochemical age like plastics. They are cheap, plentiful and useful, but environmentally disastrous. What is not recycled ends up in landfill, as a feedstock for waste-to-energy plants or as almost-indestructible litter. It often ends up crumbling into microplastics, particles of 5 millimetres or less, which are a hazard to the environment and possibly to human health. Biodegradable substitutes are nothing new. For example, polylactic

acid, made from starch, has been used commercially since the mid-1980s. But the existing options aren't ideal. For example, they don't biodegrade well outside industrial composters and they consume valuable, food-grade carbohydrates. The solution? You guessed it – more wood. Several companies in the Nordic region are working on turning forests into plastics. The European Union's upcoming ban on single-use plastics such as straws, cups and cotton buds can only accelerate the progress. "This is an enormous opportunity to replace single-use plastics with wood," says Berglund. One company well-placed to take advantage is Stora Enso, a former copper mining firm in Finland that traces its history back to the 13th century. In recent years, it has reinvented itself as "the renewable materials company", developing a range of wood-based alternatives to plastics. Its Durasense material, for example, is a 60/40 mixture of wood and polypropylene that can be reused up to six times. Another pioneering firm is Paptic, also from Finland, which is developing a material made from wood fibres to replace plastic bags. As yet, nobody has cracked the big one – drinks bottles – but numerous companies are reportedly working on it. To see what the future of plastic might look like, I visited the HQ of a start-up called Sulapac in Helsinki, Finland. Its eponymous material is 88 per cent waste wood plus a proprietary binding product made from sugar cane waste. Sulapac won't reveal what the binder is, but says it allows the wood waste to be heated to 200°C and hence processed in existing plastic moulding machinery. For the moment, Sulapac's only commercial products are jars for expensive cosmetics, but its ambitions are much bigger. "We can't yet replace single-use plastics or long-life products such as scissor handles, but everything short-term we want to replace," says co-founder Suvi Haimi. That means items like plastic cutlery, pens, combs, toothbrushes and phone cases. Sulapac material is designed to be 100 per cent biodegradable and microplastic-free. Its ideal final resting place is an industrial composter, but if it finishes up in the environment, it degrades completely within a year. "Wherever it ends up, it is better than plastic," says Haimi. And Sulapac is beautiful, warm and smooth, like a cross between wood and ceramic. The ambitions for repurposing wood don't stop there. In Liangbing Hu's lab at the University of Maryland, scientists are working on using it as a replacement for some of the world's most advanced materials. Earlier this year, he and his colleagues announced a development significant enough to be published in the journal Nature: a technology to transform soft wood into a material stronger and tougher than high-performance steel and even the titanium alloys that are used in aerospace engineering. Densified wood – they really ought to call it superwood – is made by chemically removing about half of the lignin then brutally compressing what is left at high temperature. This causes the cell

structures to collapse and the nanocellulose fibres to align and bond. The resulting material is a fifth the thickness of wood, but 12 times stronger and three times more durable. It thus possesses a desirable combination of strength and toughness. "It looks like wood though it's much lighter, and if you drop it on the floor it sounds like steel," says Hu. "It has the potential to replace steel wherever strength is needed but weight isn't." Initially that means the bodywork of vehicles and aeroplanes – Hu recently received a $3.6 million grant to develop the material as a steel substitute in cars – and perhaps ultimately moving parts. Hu and his colleagues are also looking at the potential for wood to replace expensive, heavy materials in energy storage devices. "We've been developing a technology called the wood battery where you put battery components into the pores," he says. "One application is for cellphones and vehicles where weight is important. The other is for stationary batteries, where weight isn't that important, but you want the cost to be as low as possible. That's where wood comes in, it is very cheap." Not to be outdone, Berglund has even made a wooden laser, using an organic dye embedded in the natural channels of transparent wood. "It's not a very good laser, but it is cheap and renewable," he says. Right now, there are no obvious applications for it – maybe it could be embedded in furniture as a design feature, he says. But it is yet another demonstration of what is possible, and how scientists are changing the perception of wood as a material. From these tiny acorns, is it really possible to grow a mighty wood-based economy? Materials science is part of the equation. To replace the materials of the 20th century, wood will have to overcome two other obstacles. One is demand for land. Is there enough to grow all the trees we need without affecting food production or causing mass deforestation? This is a tough question. Sustainable forestry is key to keeping a lid on global warming, but managing the competing needs of agriculture, bioenergy and forest is already a difficult balancing act. Various scenarios for how the world can develop sustainably this century produce wildly different estimates of forest cover, ranging from increases of 500 million hectares to similar decreases. And these models do not consider a massively expanded forest products industry.

Where does it all come from?

But according to Himlal Baral, a senior scientist at the Centre for International Forestry Research in Bogor, Indonesia, there is plenty of land to go around. "Certainly, there is competing demand for land," he says. "On the other hand, there is a huge amount of degraded and underutilised land available globally, between 1 and 6 billion hectares." We could use

such land, he says, to grow trees to make chemicals, structural materials and biofuels without competing with land needed for food or nature conservation. "Use of degraded and underutilised land for these products and services provides win-win solutions to mitigate climate change, and support rural livelihood and land restoration." Berglund also sees little to worry about. "In the Nordic countries, this is absolutely not a problem. If you look at annual growth and how much is harvested, we are not using all our sustainable forests." Price is another real obstacle. As yet, lignin isn't competitive with petrochemicals, and nanocellulose can cost as much as $3000 per kilogram, which is about 100 times the cost of Kevlar. But Berglund says we can't afford to worry about that. "We cannot wait until the biobased materials are cost-competitive. We are in a situation with the environment where we need to switch to renewable resources now, and work out the economy along the way." Hu is also optimistic. "I think we should gradually replace some of the old materials, and see how far wood can go." Whether this kind of optimism is enough to get the wood economy up and running, in the face of a strong market bias to petrochemicals, remains to be seen. "This material is abundant, biodegradable, renewable," says Hu. "It holds great promise. If you engineer it right, you can replace plastics, glass, metals, steel. You just need to be really open-minded." Did you hear the one about the wooden car? Yeah, it had laser headlights.

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http://www.newscientist.com/

Handheld device could detect CRISPR bioweapons before they spread

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A handheld device could spot a potential new type of bioweapon made feasible by the latest gene- editing technology. Researchers around the world are using CRISPR to make gene drives – bits of DNA that, when inserted into a living thing, can bypass the normal rules of genetic inheritance to spread widely in a population within just a few generations. Gene drives could be used for good, for example to stop the spread of malaria by adding a gene to mosquitoes that renders all male offspring infertile. This could wipe out all malaria-carrying mosquitoes in a region. However, there is also a risk of malicious use. For instance, gene drives

could be used to make the bite of harmless insects deadly, or to wipe out key pollinators. But to counter bioweapons based on gene drives, you first have to detect them, says Carina Nieuwenweg of Wageningen University in the Netherlands, who is working on the handheld detector. And that is best done with a quick field test rather than sending samples to a laboratory. With her team's device, all you would need to do is place a mosquito, for instance, in a small vial. "You just put the mosquito in and shake it once or twice, and that's enough," says Nieuwenweg. The vial is then heated to 60°C. Chemicals inside detect the DNA sequence of the CRISPR-Cas9 gene used to create gene drives. If the target DNA is present, the liquid in the vial changes colour (ChemRxiv, doi.org/c3gh). The detector was initially developed as a student project, but has since been demonstrated to Dutch intelligence services, says Nieuwenweg. She is now getting funding to work on anti-gene drive technologies from the country's defence ministry. The US is also taking the threat seriously. The Defence Advanced Research Projects Agency (DARPA) is spending $65 million on ways of countering gene drives as part of its Safe Genes program. However, Nieuwenweg says the risk of weaponised gene drives is small for now. The technology is still in its infancy and researchers have tested them in only a handful of species so far, often unsuccessfully. "I don't think we should be scared that someone is trying to make a bioweapon right now," she says, but the technology is advancing fast. The device has the potential to monitor the spread of deliberately released gene drives, says Gus McFarlane at the Roslin Institute in the UK, who studies gene drives. But anyone serious enough to create a bioweapon might use an unusual version of CRISPR with a DNA sequence that won't be detected, he says. There are easier ways of creating bioweapons than making gene drives, says McFarlane. "Realistically, I think gene drives pose little threat." Vittorio Saggiomo at Wageningen University, who also worked on the detector, agrees, but says it is still worth having a gene-drive detector just in case. "It is better to have it than not to have it. I believe in having a counter-weapon before the weapon."

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A laser technique proves effective to recover material designed to protect industrial products

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Fluoropolymers are macromolecules made up of carbon and fluoride which, due to their properties, tend to be used as non-stick and anticorrosive coatings on a wide range of material. Products in the clothing, graphic, chemical and car industries as well as different metal moulds and kitchen utensils need fluoropolymers for their coatings and to improve their features regarding sticking and resisting corrosion. These kinds of coatings tend to be quite effective due to their characteristics. They resist abrasion, they behave stably at high temperatures and their structure is not affected by most chemical agents. Nevertheless, despite their resistance, they wear away with use like any other kind of material. In order to deal with this issue, the alternative to replacing the whole piece, often times a very expensive solution, is removing the coating, taking out any impurities and taking off any parts that are attached, and recoating it. Here is where the merits of fluoropolymers become a problem. Since they are extremely resistant and chemically inert materials, they adhere to a surface and do not come off easily. To deal with this, the Manufacturing Processes Engineering research group at the University of Cordoba has validated a new method to take off these kinds of coatings using a laser technique. After doing several tests on the material, the research group characterised different parameters such as toughness, roughness and mechanical properties of the material after being exposed to the laser. The IK4-Tekniker Foundation also participated in this testing. As researcher Guillermo Guerrero Vaca, one of the authors of the paper, explained to us, the results show that the technique behaves effectively, especially for one kind of fluoropolymer, PTFE, so "we can conclude that it could be an alternative for these kinds of coatings instead of other kinds of methods." He is referring to the Nd:YAG industrial laser, which is a continuous wave and solid-state laser that possesses yttrium oxide and aluminium doped with neodymium. Though it has several applications, for instance in the field of welding as well as in ophthalmological treatments, never before has it been used for these specific kinds of materials. Despite one of its drawbacks being the costly equipment, as Professor Guerrero Vaca points out, its price has decreased over the last few years. The next step to improve its usefulness would be to make the process automatic, something that could be made possible in the future using robotic heads.

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http://www.eurekalert.org

Chemical π

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Oh dear—π day 2016 has gone by and I still haven't memorised p in what I used to call the "elementary" way that I invented some decades ago. Somebody recently suggested the much better name "Chemical π." What can I do to make sure I do it by next π day? I know— I'll write an article called "Chemical π" for The Mathematical Intelligencer. Here goes:

Let me tell you how Chemical π starts. First, I should remind you that it was proposed by several chemists, including Andreas von Antropoff and Charles Janet, that what is now called the neutron could be regarded as an atom of the element of atomic number 0, which has been called Neutronium and assigned the chemical symbol Nn.

Here is chemical π:

Using the periodic table to memorise that celebrated number

3 Neutronium 1415926535 Hydrogen 8979323846 Helium 2643383279 Lithium 5028841971 Beryllium ... You get the idea? In between the elements of atomic numbers n and n + 1, we insert the 10 decimal digits of π numbered 10n + 1 to 10n + 10. So, for instance, since Lithium and Beryllium have atomic numbers 3 and 4, the 31st to 40th digits of π appear between Li and Be making the "mouthful" Li 5028841971 Be.

Chemical π is a way to learn π with lots of advantages.

It helps to solve the forgetting problem. If you just remember π as a long string of digits, then your only name for any substring of digits in π is that substring itself. So, if you forget that substring, you've forgotten what you've forgotten! With the chemicals inserted like beads, you can say for example, I've forgotten the part between Magnesium and Aluminium and clear this up by quickly looking for it in Table 1 of this paper: Mg 0938446095 Al.

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It makes the remembering problem easier. Mnemo-technicians know that memorisation becomes easier if one attaches "colourful" things to the items one is memorising. In Chemical π, the chemicals are the colour. It divides the digits into easily digested "mouthfuls," each consisting of two adjacent elements separated by 10 digits of pi. This gives you a nice trick. Ask a friend to give you any number less than 1200 and then recite π starting at that decimal digit. For instance, if he says 314, you read the gallium (no. 31) mouthful from its fourth digit 1558817 then 48815…

It solves the stopping problem. When I first learned π to 1000 places, I triumphantly finished "...1989" to my friend John McKay. He said: "What comes next?" I realised he had a point. It was odd to know everything about the first thousand decimal digits but nothing of the next ones. I decided to add an extra 10% as "play," making 1100 digits and then 10 more digits as "play in the play," making 1110 and another digit as "play in the play in the play" and then for the play in that I asked him to look up the next digit, not tell me what it was but just whether it was 5 or more so that I would know whether to round up or down. This led to 1111 digits and a bit (binary digit). With the chemical method, the rule is that a chemically pious person need only memorise digits 10n + 1 to 10n + 10 of π when IUPAC (the International Union of Pure and Applied Chemistry) has accepted a final name for the element of atomic number n. Happily this goes just a little bit further than the play-in-the-play-in-the-play method. What I call the IUPAC "cipher" provides provisional names ending in ium for the elements from 100 to 999 by "enciphering" the digits 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 as nil, un, bi, tri, quad, pent, hex, sept, oct, enn. In this paper we abbreviate the cipher by omitting any initial letters U or u. By 2010 IUPAC had accepted permanent names for the elements up to 112 (Copernicum) and a year later it recognised the names Flerovium (114) and Livermorium (116). On January 4 2016, IUPAC accepted that elements 113, 115, 117, and 118 have been constructed, but the institutions that constructed them still don't seem to have chosen permanent names. If Charles Janet was right in his prediction that the element with atomic number 120, provisionally Unbinilium, would be the last such element, many people competing in Pi Day celebrations could achieve chemical piety forever! The nerds who read this paper will probably be interested in Janet's "Left Step" version of the periodic table, even though it has no connection with the number π. I'll describe my slight improvement of this table, which is printed in Table 3 with my mnemonic for the chemical elements it contains. It consists of two periods of length 2 = 2 x 12, two of length 8 = 2 x 22, two of length

18 = 2 x 32, and finishes with two of length 32 = 2 x 42. If started with hydrogen as Janet did, this takes us to element number 120, which he thought would be the last element to be constructed. However, this puts Helium in column 1 from the right and the other noble gasses in column 3 (again the right), and has other similar defects. These defects are cured if we start from Neutronium, when in particular the noble gasses form the column 2. This makes element 119 dislodge element 120 from the last place, which might suggest that 119 should be the last to be constructed. However, if element 120 is constructed, then it could be named Jt after Janet and the last mouthful would be Jt 8583616035 bu. Is it perhaps not too much to hope that when celebrations start at 1.59 on future Pi Days, the pious might spare a thought for the modest inventor of Chemical Pi? The chemical symbols of the following elements refer to alternative, older names. Sodium = Na = Natrium, Potassium = K = Kalium, Copper = Cu = Cuprum, Silver = Ag = Argentum, Tin = Sn = Stannum, Antimony = Sb = Stibnum, Tungsten = W = Wolfram, Gold = Au = Aurum, Mercury = Hg = Hydrargyrum, Lead = Pb = Plumbum.

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http://www.sciam.com

Advances point the way to smaller, safer batteries

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People don't ask too much from batteries: Deliver energy when it's needed and for as long as it is wanted, recharge quickly and don't burst into flames. A rash of cell phone fires in 2016 jolted consumer confidence in lithium-ion batteries, a technology that helped usher in modern portable electronics but has been plagued by safety concerns since it was introduced in the 1980s. As interest in electric vehicles revs up, researchers and industry insiders are searching for improved rechargeable battery technology that can safely and reliably power cars, autonomous vehicles, robotics and other next-generation devices. New Cornell research advances the design of solid-state batteries, a technology that is inherently safer and more energy-dense than today's lithium-ion batteries, which rely on flammable liquid electrolytes for fast transfer of chemical energy stored in molecular bonds to electricity. By starting with liquid electrolytes and then transforming them into solid polymers inside the electrochemical cell, the researchers take advantage of both liquid and solid properties to overcome key limitations in current battery designs. "Imagine a glass full of ice cubes: Some of the ice will contact the glass, but there are gaps," said Qing Zhao, a postdoctoral researcher and lead author on the study,

New research advances the design of solid-state batteries, a technology that is inherently safer and more energy-dense than today's lithium-ion batteries, which rely on flammable liquid electrolytes for fast transfer of chemical energy stored in molecular bonds to electricity.

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"Solid-State Polymer Electrolytes With In-Built Fast Interfacial Transport for Secondary Lithium Batteries," published March 11 in Nature Energy. "But if you fill the glass with water and freeze it, the interfaces will be fully coated, and you establish a strong connection between the solid surface of the glass and its liquid contents," Qing said. "This same general concept in a battery facilitates high rates of ion transfer across the solid surfaces of a battery electrode to an electrolyte without needing a combustible liquid to operate." The key insight is the introduction of special molecules capable of initiating polymerisation inside the electrochemical cell, without compromising other functions of the cell. If the electrolyte is a cyclic ether, the initiator can be designed to rip open the ring, producing reactive monomer strands that bond together to create long chain-like molecules with essentially the same chemistry as the ether. This now-solid polymer retains the tight connections at the metal interfaces, much like the ice inside a glass. Beyond their relevance for improving battery safety, solid-state electrolytes are also beneficial for enabling next-generation batteries that utilise metals, including lithium and aluminium, as anodes for achieving far more energy storage than is possible in today's state-of-the-art battery technology. In this context, the solid-state electrolyte prevents the metal from forming dendrites, a phenomenon that can short circuit a battery and lead to overheating and failure. Despite the perceived advantages of solid-state batteries, industry attempts to produce them at a large scale have encountered setbacks. Manufacturing costs are high, and the poor interfacial properties of previous designs present significant technical hurdles. A solid-state system also circumvents the need for battery cooling by providing stability to thermal changes. "Our findings open an entirely new pathway to create practical solid-state batteries that can be used in a range of applications," said senior author Lynden Archer, the James A. Friend Family Distinguished Professor of Engineering in the Smith School of Chemical and Biomolecular Engineering. According to Archer, the new in-situ strategy for creating solid polymer electrolytes is particularly exciting because it shows promise for extending cycle life and recharging capabilities of high-energy-density rechargeable metal batteries. "Our approach works for today's lithium ion technology by making it safer, but offers opportunity for future battery technology," Archer said. Other authors are doctoral students Xiaotun Liu and Sanjuna Stalin, and Kasim Khan '20. The research was supported by the Department

A prototype device used solar energy to create hydrogen fuel from seawater.

of Energy's Basic Energy Sciences program and through facilities funding from the National Science Foundation.

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Researchers create hydrogen fuel from seawater

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Stanford researchers have devised a way to generate hydrogen fuel using solar power, electrodes and saltwater from San Francisco Bay. The findings, published March 18 in Proceedings of the National Academy of Sciences, demonstrate a new way of separating hydrogen and oxygen gas from seawater via electricity. Existing water-splitting methods rely on highly purified water, which is a precious resource and costly to produce. Theoretically, to power cities and cars, "you need so much hydrogen it is not conceivable to use purified water," said Hongjie Dai, J.G. Jackson and C.J. Wood professor in chemistry at Stanford and co-senior author on the paper. "We barely have enough water for our current needs in California." Hydrogen is an appealing option for fuel because it doesn't emit carbon dioxide, Dai said. Burning hydrogen produces only water and should ease worsening climate change problems. Dai said his lab showed proof-of-concept with a demo, but the researchers will leave it up to manufacturers to scale and mass produce the design.

Tackling corrosion

As a concept, splitting water into hydrogen and oxygen with electricity—called electrolysis—is a simple and old idea: a power source connects to two electrodes placed in water. When power turns on, hydrogen gas bubbles out of the negative end—called the cathode—and breathable oxygen emerges at the positive end—the anode. But negatively charged chloride in seawater salt can corrode the positive end, limiting the system's lifespan. Dai and his team wanted to find a way to stop those seawater components from breaking down the submerged anodes. The researchers discovered that if they coated the anode with layers that were rich in negative charges, the layers repelled chloride and slowed down the decay of the underlying metal. They layered nickel-iron hydroxide on top of nickel sulfide, which covers a nickel foam core. The nickel foam acts as a conductor—transporting electricity from the power source—and the nickel-iron hydroxide sparks the electrolysis, separating water into oxygen and hydrogen. During electrolysis, the nickel sulfide evolves into a negatively charged layer that protects the anode. Just as the negative

ends of two magnets push against one another, the negatively charged layer repels chloride and prevents it from reaching the core metal. Without the negatively charged coating, the anode only works for around 12 hours in seawater, according to Michael Kenney, a graduate student in the Dai lab and co-lead author on the paper. "The whole electrode falls apart into a crumble," Kenney said. "But with this layer, it is able to go more than a thousand hours." Previous studies attempting to split seawater for hydrogen fuel had run low amounts of electric current, because corrosion occurs at higher currents. But Dai, Kenney and their colleagues were able to conduct up to 10 times more electricity through their multi-layer device, which helps it generate hydrogen from seawater at a faster rate. "I think we set a record on the current to split seawater," Dai said. The team members conducted most of their tests in controlled laboratory conditions, where they could regulate the amount of electricity entering the system. But they also designed a solar-powered demonstration machine that produced hydrogen and oxygen gas from seawater collected from San Francisco Bay. And without the risk of corrosion from salts, the device matched current technologies that use purified water. "The impressive thing about this study was that we were able to operate at electrical currents that are the same as what is used in industry today," Kenney said.

Surprisingly simple

Looking back, Dai and Kenney can see the simplicity of their design. "If we had a crystal ball three years ago, it would have been done in a month," Dai said. But now that the basic recipe is figured out for electrolysis with seawater, the new method will open doors for increasing the availability of hydrogen fuel powered by solar or wind energy. In the future, the technology could be used for purposes beyond generating energy. Since the process also produces breathable oxygen, divers or submarines could bring devices into the ocean and generate oxygen down below without having to surface for air. In terms of transferring the technology, "one could just use these elements in existing electrolyser systems and that could be pretty quick," Dai said. "It's not like starting from zero—it's more like starting from 80 or 90 percent."

Phys.org, 18 March 2019

http://phys.org

Strong enough not only for use in impact protection systems in cars, but able to absorb the shock waves produced by a detonation. Those are just some of the properties shown by the metallic foams.

Gossip

Lightweight metal foams become bone hard and explosion proof after being nanocoated

2019-03-20

Strong enough not only for use in impact protection systems in cars, but able to absorb the shock waves produced by a detonation. Those are just some of the properties shown by the metallic foams developed by materials scientists Stefan Diebels and Anne Jung at Saarland University. Their super lightweight and extremely strong metal foams can be customised for a wide range of applications. The inspiration for the new foam system came from nature: bones. Using a patented coating process, the Saarbrücken team is able to manufacture highly stable, porous metallic foams that can be used, for example, in lightweight construction projects. The initial lattice substrate is either an aluminium or polymer foam, not dissimilar to a kitchen sponge. The research team and the start-up company that their work has spawned (Mac Panther Materials GmbH, Bremen, Germany) will be at Hannover Messe where they will be showcasing their process from the 1st to the 5th of April at the Saarland Research and Innovation Stand (Hall 2, Stand B46). Bones are one of nature's many ingenious developments. They are strong and stable and can cope with loads almost as well as steel. But despite their strength, they are light enough to be easily moved by humans and animals. The secret lies in the combination of a hard exterior shell that encases a porous lattice-like network of bone tissue in the interior of the bone. This structure saves on material and reduces weight. Metal foams are able to mimic these naturally occurring bone structures. The synthetic foams are porous, open-cell structures that are manufactured from metals and that have the appearance of a sponge. The metal foams currently available are certainly lightweight, but the production process is both complicated and expensive. And the stability of the sponge-like foam structure is still too weak and not resilient enough for many applications. This is certainly true of aluminium foam, which is the most common type produced today. 'This is the reason why metal foams have so far not had any real market impact,' explains materials scientist Stefan Diebels, Professor of Applied Mechanics at Saarland University. His research team has found a way to significantly strengthen the lattice structure of the metal foams, producing a lightweight, extremely stable and versatile material. Diebels and materials scientist Dr. Anne Jung have developed a patented procedure for coating the individual struts that make up the open-cell interior lattice. As a result, the exterior of the foam is stronger and more stable and the structure is now able to withstand extreme loads. However, the treated foam remains amazingly light. The team started out using aluminium foams but are now

using inexpensive polyurethane foams whose strength comes entirely from the thin metal coating applied to the lattice structure. 'The resulting metal foams have a low density, a large surface area but a small volume. In relation to their weight, these foams are extremely strong and rigid,' says Stefan Diebels. In fact, they are so strong that they are being used as mobile barriers to provide protection from the shock waves caused by explosions. Even when exposed to underwater detonations, the foams simply 'swallow' the resulting sound and pressure waves, thus protecting sensitive marine organisms from the effects of these powerful shock waves. 'Most of the applications we focus on are generally less spectacular, such as the use of our foams in lightweight construction,' explains Dr. Anne Jung, a senior research scientist in Diebels' group. Dr. Jung actually completed two doctoral theses. She was awarded the German Thesis Award from the Körber Foundation for 'the most important dissertation of the year with significant relevance for society' for her first doctoral theses on the subject of metal foams. Many products can be made lighter and more stable by drawing inspiration from nature's design ingenuity. For example, load-bearing structures in cars and aeroplanes could be manufactured from the metal foam. 'They can be installed as reinforcing struts in the bodywork, while also providing impact protection. The struts can take up large amounts of energy and are able to absorb the force of a collision when parts of the porous core fracture under impact,' explains Anne Jung. There are numerous areas of application for these foams, such as in catalysis, as the material is porous and thus allows liquids and gases to flow through it, or for shock absorption or as a heat shield, as the foams exhibit excellent heat resistance. The foam material can also be used for electromagnetic screening or in architectural applications, where it finds use as sound-absorbing cladding or as a building design element. The coating is applied in an electroplating bath. The most challenging aspect of the electroplating process was achieving a uniform coating of the ultrathin layer throughout the entire interior of the foam structure. 'The problem', explains Anne Jung, 'is that the metallic foam acts as a Faraday cage.' As the interior of the foam is surrounded by electrically conducting material, electric current and thus the coating is diverted to the exterior of the foam body and does not travel through the interior of the foam - it's similar to what happens when lightning strikes a car. The breakthrough came when Anne Jung decided to use a special anode cage, which allows her to apply a uniform, nanocrystalline coating throughout the entire lattice network. 'The patented method also functions on the industrial scale with foams with very large surface areas,' adds Jung. The Saarbrücken team has authored numerous important scientific papers in the field and is now regarded as one of the world's leading research groups in the

micromechanical characterisation of these porous metal lattices. Using an array of experiments, simulations, tension and compression testing, optical microscopy and x-ray computed tomography, the research team have examined the structure, pore geometry and curvature of the struts and have shown how varying the thickness of the nanocoating can impart different properties to the foam materials. By varying the composition of the coating, its thickness or the pore size, the team is able to customize foams to meet different application needs. For example, nanocoating the open-cell lattice structure with nickel produces particularly strong foams, with copper the foam material exhibits high thermal conductivity, with silver they have good antibacterial properties, and with gold the foam is highly decorative. The Saarbrücken research group, which includes students and doctoral researchers, are continuing to work on optimizing both the production process and the material itself.

Background

In order to facilitate the commercial and industrial application of their research results, the Saarbrücken researchers have entered into a technology transfer pilot project together with Saarland University's Knowledge and Technology Transfer Office (KWT) and the external start-up partners Dr. Andreas Kleine and Michael Kleine, and have established the company Mac Panther Materials GmbH with headquarters in Bremen. Both Dr. Jung and Professor Diebels have a stake in the new company as does Saarland University's knowledge and technology transfer company WuT.

EurekAlert, 14 March 2019

http://www.eurekalert.org

Researchers find new way to remove PFOS from industrial wastewater

Defects help nanomaterial soak up more pollutant in less time

2019-03-20

Cleaning pollutants from water with a defective filter sounds like a non-starter, but a recent study by chemical engineers at Rice University found that the right-sized defects helped a molecular sieve soak up more perfluorooctanesulfonic acid (PFOS) in less time. In a study in the American Chemical Society journal ACS Sustainable Chemistry and Engineering, Rice University researchers Michael Wong, Chelsea Clark and colleagues showed that a highly porous, Swiss cheese-like nanomaterial called a metal-organic framework (MOF) was faster at soaking up PFOS

from polluted water, and that it could hold more PFOS, when additional nanometre-sized holes ("defects") were built into the MOF. PFOS was used for decades in consumer products like stain-resistant fabrics and is the best-known member of a family of toxic chemicals called "per- and polyfluoroalkyl substances" (PFAS), which the Environmental Protection Agency (EPA) describes as "very persistent in the environment and in the human body -- meaning they don't break down and they can accumulate over time." Wong, professor and chair of Rice's Department of Chemical and Biomolecular Engineering and a professor of chemistry, said, "We are taking a step in the right direction toward developing materials that can effectively treat industrial wastewaters in the parts-per-billion and parts-per-million level of total PFAS contamination, which is very difficult to do using current technologies like granular activated carbon or activated sludge-based systems." Wong said MOFs, three-dimensional structures that self-assemble when metal ions interact with organic molecules called linkers, seemed like good candidates for PFAS remediation because they are highly porous and have been used to absorb and hold significant amounts of specific target molecules in previous applications. Some MOFs, for example, have a surface area larger than a football field per gram, and more than 20,000 kinds of MOFs are documented. In addition, chemists can tune MOF properties -- varying their structure, pore sizes and functions -- by tinkering with the synthesis, or chemical recipe that produces them. Such was the case with Rice's PFAS sorbent. Clark, a graduate student in Wong's Catalysis and Nanomaterials Laboratory, began with a well-characterised MOF called UiO-66, and conducted dozens of experiments to see how various concentrations of hydrochloric acid changed the properties of the final product. She found she could introduce structural defects of various sizes with the method -- like making Swiss cheese with extra-big holes. "The large-pore defects are essentially their own sites for PFOS adsorption via hydrophobic interactions," Clark said. "They improve the adsorption behaviour by increasing the space for the PFOS molecules." Clark tested variants of UiO-66 with different sizes and amounts of defects to determine which variety soaked up the most PFAS from heavily polluted water in the least amount of time. "We believe that introducing random, large-pore defects while simultaneously maintaining the majority of the porous structure played a large role in improving the adsorption capacity of the MOF," she said. "This also maintained the fast adsorption kinetics, which is very important for wastewater remediation applications where contact times are short." Wong said the study's focus on industrial concentrations of PFAS sets it apart from most previously published work, which has focused on cleaning polluted drinking water to meet the current federal standards of 70 parts

per trillion. While treatment technologies like activated carbon and ion exchange resins can be effective for cleaning low-level concentrations of PFAS from drinking water, they are far less effective for treating high-concentration industrial waste. Although PFAS use has been heavily restricted by international treaty since 2009, the chemicals are still used in semiconductor manufacturing and chrome plating, where wastewater can contain as much as one gram of PFAS per litre of water, or about 14 billion times the current EPA limit for safe drinking water. "In general, for carbon-based materials and ion-exchange resins, there is a trade-off between adsorption capacity and adsorption rate as you increase the pore size of the material," Wong said. "In other words, the more PFAS a material can soak up and trap, the longer it takes to fill up. In addition, carbon-based materials have been shown to be mostly ineffective at removing shorter-chain PFASs from wastewater. "We found that our material combines high-capacity and fast-adsorption kinetics and also is effective for both long- and short-chain perfluoroalkyl sulfonates," he said. Wong said it's difficult to beat carbon-based materials in terms of cost because activated carbon has been a mainstay for environmental filtration for decades. "But it's possible if MOFs become produced on a large-enough scale," he said. "There are a few companies looking into commercial-scale production of UiO-66, which is one reason we chose to work with it in this study."

Science Daily, 13 March 2019

http://www.sciencedaily.com

Curiosities

Air pollution may impact foetal cardiovascular system, study says

2019-03-21

Microscopic particles in air pollution inhaled by pregnant women may damage foetal cardiovascular development, according to a study by Rutgers researchers. The study, published in the journal Cardiovascular Toxicology, found that early in the first trimester and late in the third trimester were critical windows during which pollutants most affect the mother's and foetus' cardiovascular systems. "These findings suggest that pregnant women, women of child-bearing years who may be pregnant and those undergoing fertility treatments should avoid areas known for high air pollution or stay inside on high-smog days to reduce their exposure," said Phoebe Stapleton, assistant professor at Rutgers Ernest Mario School of Pharmacy and a faculty member at Rutgers Environmental and Occupational Health Sciences Institute. "Pregnant women should also consider monitoring their indoor air quality." What a mother inhales affects her circulatory system, which is constantly adapting to supply adequate blood flow to the foetus as it grows. Exposure to these pollutants can constrict blood vessels, restricting blood flow to the uterus and depriving the foetus of oxygen and nutrients, which can result in delayed growth and development. It can also lead to common pregnancy complications, such as intrauterine growth restriction. The study looked at how the circulatory systems of pregnant rats and their foetuses were affected by a single exposure to nanosized titanium dioxide aerosols—a surrogate for particles found in typical air pollution—during their first, second and third trimesters. The results were compared to pregnant rats that were exposed only to high-efficiency filtered air. The researchers found that exposures to pollutants early in gestation significantly impact a foetus's circulatory system, specifically the main artery and the umbilical vein. Later exposure had the most impact on foetal size since the restricted blood flow from the mother deprives the foetus of nutrients in this final stage. In non-pregnant animals, even a single exposure to these nanoparticles has been linked to impaired function of the arteries in the uterus. The study found that one exposure late in pregnancy can restrict maternal and foetal blood flow, which can continue to affect the child into adulthood. "Although nanotechnology has led to achievements in areas such as vehicle fuel efficiency and renewable energy, not much is known about how these particles affect people at all stages of development," said Stapleton. By 2025, the annual global production of nanosized titanium dioxide particles is projected to reach 2.5 million metric tons. Besides representing the very

small particles found in air pollution, titanium dioxide also is commonly used in many personal care products including sunscreens and face powders.

Medical Xpress, 11 March 2019

http://medicalxpress.com

Smoking, high blood pressure, diabetes and obesity each linked to unhealthy brains

2019-03-21

Factors that influence the health of our blood vessels, such as smoking, high blood and pulse pressures, obesity and diabetes, are linked to less healthy brains, according to research published in the European Heart Journal today. The study examined the associations between seven vascular risk factors and differences in the structures of parts of the brain. The strongest links were with areas of the brain known to be responsible for our more complex thinking skills, and which deteriorate during the development of Alzheimer's disease and dementia. The researchers, led by Dr. Simon Cox, a senior research associate at the Centre for Cognitive Ageing and Cognitive Epidemiology at the University of Edinburgh (UK), examined MRI scans of the brains of 9,772 people, aged between 44 and 79, who were enrolled in the UK Biobank study—one of the largest groups of people from the general population to have data available on brain imaging as well as general health and medical information. All had been scanned by a single scanner in Cheadle, Manchester, and most of the participants were from the north-west of England. This is the world's largest single-scanner study of multiple vascular risk factors and structural brain imaging. The researchers looked for associations between brain structure and one or more vascular risk factors, which included smoking, high blood pressure, high pulse pressure, diabetes, high cholesterol levels, and obesity as measured by body mass index (BMI) and waist-hip ratio. These have all been linked to complications with the blood supply to the brain, potentially leading to reduced blood flow and the abnormal changes seen in Alzheimer's disease. They found that, with the exception of high cholesterol levels, all of the other vascular risk factors were linked to greater brain shrinkage, less grey matter (tissue found mainly on the surface of the brain) and less healthy white matter (tissue in deeper parts of the brain). The more vascular risk factors a person had, the poorer was

their brain health. Dr. Cox said: "The large UK Biobank sample allowed us to take a comprehensive look at how each factor was related to many aspects of brain structure. We found that higher vascular risk is linked to worse brain structure, even in adults who were otherwise healthy. These links were just as strong for people in middle-age as they were for those in later life, and the addition of each risk factor increased the size of the association with worse brain health. "Importantly, the associations between risk factors and brain health and structure were not evenly spread across the whole brain; rather, the areas affected were mainly those known to be linked to our more complex thinking skills and to those areas that show changes in dementia and 'typical' Alzheimer's disease. Although the differences in brain structure were generally quite small, these are only a few possible factors of a potentially huge number of things that might affect brain ageing." Smoking, high blood pressure and diabetes were the three vascular risk factors that showed the most consistent associations across all types of brain tissue types measured. High cholesterol levels were not associated with any differences in the MRI scans. To quantify the size of the differences they observed, Dr. Cox explained: "We compared people with the most vascular risk factors with those who had none, matching them for head size, age and sex. We found that, on average, those with the highest vascular risk had around 18ml, or nearly 3%, less volume of grey matter, and one-and-a-half times the damage to their white matter—the brain's connective tissue—compared to people who had the lowest risk; 18ml is slightly more than a large tablespoon-full, or a bit less than a small, travel-sized toothpaste tube." He said that the findings showed the potential of making lifestyle changes to improve brain and cognitive ageing. "Lifestyle factors are much easier to change than things like your genetic code—both of which seem to affect susceptibility to worse brain and cognitive ageing. Because we found the associations were just as strong in mid-life as they were in later life, it suggests that addressing these factors early might mitigate future negative effects. These findings might provide an additional motivation to improve vascular health beyond respiratory and cardiovascular benefits." Limitations of the study include the fact that it does not include people over the age of 79 and that UK Biobank participants tend to live in less deprived areas, which may restrict how the findings can be generalised to other populations. As the researchers were measuring brain structures only, and were not carrying out functional brain imaging or tests of thinking skills, they cannot show in this study how the changes in brain structure might impact cognitive function, but other studies have shown the relationship between increased numbers of vascular risk factors and worse or declining thinking skills, and dementia. Now the researchers plan to measure the

links between vascular risk factors and thinking skills in the UK Biobank participants and in other groups too. In addition, they are following older people, and carrying out multiple scans and tests of thinking skills. They hope this will tell them more about the role that vascular risk factors play in the decline of different types of thinking skills and which areas of the brain are implicated. They also hope that the findings will motivate future work to understand the biological mechanisms through which different sources of vascular risk might be related to different brain areas and tissues.

Medical Xpress, 11 March 2019

http://medicalxpress.com

Three ways studying organic chemistry changes the brain

2019-03-21

A new study using multiple imaging modalities shows that learning scientific information results in changes in the actual structure of memory-related areas of the brain.

Academic learning is about gaining new knowledge and skill, but only recently has it been possible to see new knowledge appear in a human brain. A new study from Carnegie Mellon University researchers using multiple imaging modalities shows that learning scientific information results in changes in the actual structure of memory-related areas of the brain, changes due to the encoding of the new information in these memory-related brain areas, and changes in the coordination among the network nodes that jointly contain the new information. "These new discoveries about the neuroscience of learning open the possibility of informing and enhancing instructional methods in science," said Marcel Just, the D.O. Hebb University Professor of Psychology at CMU's Dietrich College of Humanities and Social Sciences. For the study, Just and co-author Timothy Keller, adjunct professor of psychology, taught college students who were not chemistry majors the names and molecular structure of nine organic compounds, including ethanol, while the students were in an MRI scanner. Using three different types of brain imaging, the researchers found evidence of the three types of changes in the brain, all occurring in exactly the same brain location. One of the

methods measured the movement of water molecules in the brain. Previous histological studies of rodent brains have used this diffusion-based imaging method. As rats learned the layout of a maze, researchers detected decreases in water molecule movement in the left hippocampus. When this method was applied to human participants learning the names and structures of organic compounds, it revealed a decrease in water diffusivity primarily in the CA (Cornu Ammonis) portion of the left hemisphere hippocampus. "The hippocampus is a brain structure that is critical for learning new knowledge, and that is precisely where the water molecules slowed down, indicating that the tissues in these students' brains were changing, probably due to synaptic changes," Keller said. The second method made use of the fact that individual concepts have unique representations or neural signatures in the brain that can be identified using functional MRI (fMRI). This approach uses machine learning to detect these representations based on the person's brain activation pattern. The researchers used this method to identify which of the nine compounds a participant was thinking about, based on the associated brain activation pattern. The researchers found they could identify the neural signatures by looking precisely at that part of the hippocampus where the water molecule motion indicating tissue changes had occurred. The two types of changes occurred in the same 1.3 cubic cm of hippocampus. A third type of change reflected the development of a brain network that contained the full brain signature of the organic compounds. Not only was the hippocampus involved in these representations, but so were other brain regions, most prominently a region known to support visualization of 3-D structures, the intraparietal sulcus (IPS). The third brain change was an increase in the synchronisation of the activity in that very same region of the hippocampus and the IPS, indicating that a network of brain areas showed increased coordination to collectively represent the multiple facets of the concepts. These three different types of measures -- MR (Magnetic Resonance)-diffusion measures of diffusivity change, fMRI measures of the location of the newly acquired concepts and fMRI-based measures of synchronisation -- showed evidence of microstructural, informational and network change in the left hippocampus during the learning of the organic compounds. The findings hold promise for improving the effectiveness of teaching and learning science. "For example, a new student's neural representations of a set of key concepts could be compared to those of a successful advanced student to determine whether neural similarity to an expert is an accurate predictor of academic mastery of the concepts," Just said. The study, "Converging measures of neural change at the microstructural, informational, and cortical network levels in the hippocampus during the learning of the

structure of organic compounds," has been published in the journal Brain Structure and Function.

Science Daily, 7 March 2019

http://www.sciencedaily.com

What's the world's most widely used herbicide doing to tiny critters?

2019-03-21

As the active ingredient in Bayer's Roundup herbicide is increasingly scrutinised for human health impacts, scientists say it also could be altering the wildlife and organisms at the base of the food chain. Glyphosate is one of the most widely used herbicides in history. Farmers in 2014 sprayed enough of the chemical to cover every acre of cropland in the entire world with nearly a half-pound of the herbicide, according to a 2016 study published in Environmental Sciences Europe. Long thought to be relatively benign to non-target plants and animals, evidence is growing that glyphosate, the active ingredient of Roundup, may impact the metabolism, growth and reproduction of aquatic creatures and could be altering the essential gut bacteria of animals such as bees. Such impacts could have serious unexpected impacts on the tiny critters that form the base of the animal food chain, say environmental researchers, who warn the ecological impacts are likely to grow as glyphosate levels build up in the environment. "No herbicide in the history of the world has ever been used this heavily. It's a completely unprecedented case," Charles Benbrook, an agricultural economist and author of the 2016 study, told EHN.

Ecological impacts emerge

Glyphosate has been used as a broad-spectrum herbicide, meaning it kills all vegetation it's sprayed on, since the 1970s. Its use at the outset, however, was limited. Farmers and land managers could only spray it where they wanted to kill all vegetation, for instance, between the rows in orchards or vineyards, in industrial yards, or along train tracks or powerline rights of way. That all changed in 1996, when the Missouri-based agrochemical company Monsanto (now part of the pharmaceutical giant Bayer) introduced glyphosate-tolerant crops—first corn, then

soybeans, cotton and others. Farmers could spray it on and around their fields without accidentally killing their crops. The chemical soon became the most heavily used herbicide in history. Global glyphosate use has risen nearly 15-fold since the mid-90s, with an estimated 19 percent of global use happening in the U.S. alone. Since this change, much has been made about the potential health impacts to humans from widespread use. In 2015, the World Health Organization classified glyphosate as "probably carcinogenic to humans" due to a growing body of research linking glyphosate to non-Hodgkin lymphoma and other cancers. In August, a U.S. groundskeeper won a landmark lawsuit against Monsanto, saying his deadly form of non-Hodgkin lymphoma was due to years of exposure to the company's herbicide. Monsanto and its German owner Bayer now face more than 9,000 similar lawsuits. The company repeatedly has maintained there is no link between glyphosate and cancer. Numerous studies in laboratory animals, too, have suggested the chemical may have reproductive effects at levels considered safe by the U.S. Environmental Protection Agency. However, at the time it was introduced, glyphosate was considered a lot safer than other broad-spectrum herbicides, such as paraquat—which could cause deadly poisoning if breathed in or swallowed. Glyphosate, on the other hand, was considered "practically non-toxic" by the U.S. Environmental Protection Agency. That's because glyphosate kills plants by blocking a step in a series of chemical reactions, called the shikimate pathway. Plants use this pathway to make the nutrients they need for growth. Animals and humans don't have this pathway. We get our essential nutrients, instead, from the foods we eat. "If you gave me a compound that inhibits a pathway not present in animals—without knowing anything else about the compound—I would not expect that compound to be very toxic to animals," Nico van Straalen, an ecotoxicologist at Free University Amsterdam in the Netherlands, told EHN. In addition to the increasing evidence the herbicide may harm human health, this supposed non-toxicity doesn't square with the effects that van Straalen and other environmental researchers have observed on tiny organisms at the base of the food chain. The Food and Agriculture Organization of the United Nations first expressed concern about the food chain effects of glyphosate in 2005, after research showed that glyphosate residues can stick around in water and soil for several months, maybe even years. That means it has the potential to build up to higher levels in the environment with each use. In aquatic and terrestrial environments, researchers have linked changes in metabolism, growth, behaviour and reproduction of certain fishes, molluscs and insects with exposure to glyphosate-containing herbicides. A recent study by researchers in France, for instance, showed that mosquito larvae dosed with glyphosate amounts

similar to those found in the environment learned the difference between dangerous and non-dangerous shadows in the water slower than larvae not dosed with glyphosate. Mosquito larvae are an important food source for many bird, fish, and amphibian species. Those dosed with glyphosate were slower to habituate to a non-threatening shadow, which means they wasted too much energy diving below the surface when they didn't need to—a behaviour linked with larval deaths. The findings, published in 2018 in the journal Environmental Pollution, weren't the first to suggest cognitive impacts of glyphosate to insect species. Studies in bees have suggested that glyphosate may affect their learning and increases how much time it takes them to find their hives—impacts that could have long-term consequences for colony health. Several experiments with mussels, crayfish and other aquatic invertebrates, to date, have showed that exposure to Roundup or glyphosate can induce a slew of changes to cellular metabolic and reproductive pathways. However, it's not yet clear what these changes mean for the health of invertebrate populations in the wild. Researchers can't entirely explain these associations. Some experts say that additional chemicals in glyphosate mixtures, called adjuvants, that help improve herbicide activity, may be partially to blame. Studies in human cell lines suggest that adjuvants found in some Roundup formulations may be more toxic than the glyphosate active ingredient itself, though studies on the effects of adjuvants in wildlife are lacking. Others suspect that glyphosate may target biochemical pathways that we don't yet know about. Little research has been done to assess the effects of glyphosate on the microscopic bacteria and algae—the autotrophs at the base of all aquatic and terrestrial food chains. Messing with the base of the food chain, say environmental researchers, could have profound ecological effects.

Microbial consequences

Some clues are starting to emerge that investigating the effects of glyphosate on microorganisms may be key to understanding its environmental effects. "We've barely begun to investigate the microbiomes of animals and soil as possible targets for glyphosate toxicity," van Straalen said. Some of the bacteria and fungi that form the invisible scaffolding of our ecosystems use the shikimate pathway--the same series of chemical reactions that glyphosate blocks—to produce essential nutrients. Two studies in 2018 found that glyphosate could be harming honey bees by targeting the specialised bacteria that honey bees harbor in their gut. These bacteria use the shikimate pathway,

so researchers hypothesised they may be susceptible to glyphosate's effects. They think these bacteria may be involved in helping the honey bee immune system fight off infection. "One effect is that disruption of the microbiota by glyphosate seems to make the bees more susceptible to opportunistic pathogens," Nancy Moran, a bee researcher at the University of Texas at Austin, told EHN. She is a senior author of one of the bee studies, published in the Proceedings of the National Academy of Sciences, last September. Moran and her colleague at UT Austin, Erick da Silva Motta, said it's too soon to know whether glyphosate could be having similar impacts on the gut bacteria of other animal species. Aside from a few studies in earthworms and ruminant farm animals, few studies have looked at potential effects of the chemical on the microbiome. "Gut bacteria have different roles and different levels of importance in different species," Moran told EHN. One of the main challenges in studying the effects of glyphosate on animals such as bees is that we don't really know how often and how much they are exposed to the herbicide in real life after it is sprayed in a field. That's important information to have when trying to set up experiments that test realistic exposure scenarios, da Silva Motta told EHN. Some scientists worry about the effects that glyphosate may have on soil microbes. Many bacteria and fungi in the soil environment are sensitive to glyphosate, but some are naturally resistant, Maria Finckh, a plant pathologist at the University of Kassel in Germany, told EHN. That means certain microbes might survive better than others under heavy glyphosate use. Soil microbes play a huge role in essential Earth processes such as carbon and nutrient cycling. Any selective pressure that might limit the ability of soils to carry out these important functions could have serious environmental ramifications, Finckh and others have warned.

A problem of scale

The environmental impacts that researchers are beginning to link to glyphosate and glyphosate-based herbicides may indicate a major problem with the scale at which we've applied the herbicide, Benbrook said. There's an old saying in toxicology: "The dose makes the poison." It speaks to the tenet that all chemical substances—even water or oxygen—can be toxic if there's too much of it for a biological system to handle. It's possible that the environmental effects we are beginning to see with glyphosate-based herbicides have a lot more to do with the amount of the stuff we've put into the environment than the intrinsic toxicity of the chemical, he explained. "It's probable this would have happened with

whatever herbicide had been associated with the [genetically engineered] crop revolution. It just happened to be glyphosate," he said.

Environmental Health News, 18 March 2019

http://www.environmentalhealthnews.org/

People puffing e-cigs are more likely to have heart attacks, strokes and depression

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A new, yet to-be-published study of nearly 100,000 Americans finds e-cigarette users are 56 percent more likely to have a heart attack and 30 percent more likely to have a stroke than non-users. "These data are a real wake-up call and should prompt more action and awareness about the dangers of e-cigarettes," said Dr. Mohinder Vindhyal, assistant professor at the University of Kansas School of Medicine Wichita and the study's lead author, in a statement. The research, which will be presented on March 18 at the American College of Cardiology's 68th Annual Scientific Session, is the latest evidence that the fast rise of e-cigarettes—often marketed as a way to quit traditional tobacco use—may be leaving users with serious health impacts and comes as the feds crackdown on e-cigarette sales to children. E-cigarettes come in many varieties but most are battery operated and heat a liquid that contains nicotine, solvents, and sometimes flavourings and other chemicals, to create a vapor that is inhaled, which is often referred to as vaping. Researchers examined data from 96,467 people from the National Health Interview Survey, which is run by the U.S. Centres for Disease Control and Prevention. They had information from 2014, 2016 and 2017 and looked at whether or not people used e-cigarettes and rates of high blood pressure, heart attacks, strokes, and depression and anxiety. Compared to non-users, they found e-cigarette users were 56 percent more likely to have a heart attack and 30 percent more likely to suffer a stroke. Users reported 10 percent more coronary artery disease problems and 44 percent more circulatory problems. In addition, users were twice as likely to have depression or anxiety. "When the risk of heart attack increases by as much as 55 percent among e-cigarettes users compared to non-smokers, I wouldn't want any of my patients nor my family members to vape," Vindhyal said. "When we dug deeper, we found that regardless of how frequently someone uses e-cigarettes, daily or just on some days, they are still more

likely to have a heart attack or coronary artery disease." Vindhyal and colleagues also looked at risk from traditional tobacco use and it was even worse: Compared to non-users, traditional tobacco users were 165 percent more likely to have a heart attack and 78 percent more likely to have a stroke. "Cigarette smoking carries a much higher probability of heart attack and stroke than e-cigarettes, but that doesn't mean that vaping is safe," Vindhyal said. The study comes just a couple months after another national study that examined data from 400,000 Americans and linked e-cigarette use with a 70 percent higher risk of stroke, 60 percent higher risk of heart attacks. In 2017, researchers found college students that reported depression symptoms were more likely to start smoking e-cigarettes. The study doesn't point to potential causes of the increased health risks, but there are multiple chemicals in e-cigarettes for flavouring and to create the vapor that could be targeting blood vessels and impacting the heart.

Feds take aim at sales to children

E-cigarettes are a fast-growing market—an estimated 1 out of 20 people in the U.S. are users, and there are an estimated 460 brands. Regulators are scrambling to catch up. Just this week U.S. Food and Drug Administration Commissioner Dr. Scott Gottlieb put out a strong statement calling kids' e-cigarette use an "epidemic" and outlined actions to stop children's access to the products. The letter called out retailers such as Walgreen Co., 7-Eleven, and gas stations such as Marathon, Exxon, Sunoco, BP, Citgo and Mobil, for having "disturbingly high rates of violations for illegal sales of tobacco products to minors." "Companies should be on notice that the FDA is considering additional enforcement avenues to address high rates of violations," Gottlieb wrote. "Ignoring the law and then paying associated fines and penalties should not simply be viewed as a cost of doing business.' The next day, Gottlieb, who was known even prior to the letter for his aggressive actions to regulate tobacco and e-cigarette businesses, unexpectedly announced that he would resign at the end of the month.

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The Toxic Consequences of America's Plastics Boom

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Curiosities

A beach at sunset. The sky is streaked peach and mauve, the wind cool and briny. A long line of dump trucks idles at the edge of the waves, each full of plastic—bags and milk jugs and floss containers, hair clips, shrink wrap, fake ferns, toys, and spatulas. Every minute, one of the trucks lifts its bed and deposits a load of trash into the sea. The dump trucks aren't real, but the trash is. No one knows exactly how much plastic leaks into the oceans every year, but one dump truck per minute—8 million tons per year—is a midrange estimate. Plastic waste usually begins its journey on land, where only 9 percent of it is recycled. The rest is thrown away, burned, or buried, left to wash into streams and rivers or to blow out to sea. Once in the ocean, the plastic drifts or sinks. The sun and the waves break it down into tiny particles that resemble plankton. Birds and fish and other sea creatures eat it and begin to starve. One analysis predicts that by 2050, the plastic in the oceans will outweigh the fish. Some of the trash winds up in one of five current systems in the oceans known as gyres, where it forms a slowly circulating plastic soup. The Great Pacific Garbage Patch is the largest of these zones, spanning an area twice the size of Texas between Hawaii and California, a merry-go-round of the remains of global consumption. Researchers have found small plastic shards and large objects in the gyre: hard hats and Game Boys and milk crates and enormous tangles of fishing nets, all swirling in a smog of microplastics. Often inaccurately described as a solid island, the garbage patch has become a potent symbol of the world's plastic problem, alongside viral photos of a sea horse clutching a Q-tip, a sea turtle with a straw wedged deep in its nostril, and a dead adolescent albatross with a stomach full of jewel-like plastic shards. These images have helped raise the alarm about plastic waste around the world, inspiring responses ranging from weekend beach sweeps to the Ocean Clean-up, a controversial and expensive effort to collect the trash in the Great Pacific gyre. Even the corporations that produce plastics have grown alarmed. In January, dozens of companies including Dow, ExxonMobil, Chevron Phillips, and Formosa Plastics Corporation announced the Alliance to End Plastic Waste, with an initial commitment of $1 billion to fund recycling and clean-up. But those same petrochemical giants are about to make the plastic problem worse. Companies are investing $65 billion to dramatically expand plastics production in the United States, and more than 333 petrochemical projects are underway or newly completed, including brand-new facilities, expansions of existing plants, vast networks of pipelines, and shipping infrastructure. This is a sharp reversal of fortune for American plastics manufacturers. Just over a decade ago, major plastics makers shed tens of thousands of jobs as cheaper operating costs in Asia and the Middle East lured production overseas. Now, thanks to the fracking

revolution, producing plastic has become radically cheaper in the United States, leading to a glut of raw materials for its creation. The economic winds have shifted so profoundly that petrochemical companies have declared a "renaissance" in American plastics manufacturing. In turn, plastic is becoming an increasingly important source of profit for Big Oil, providing yet another reason to drill in the face of climate change. The expected result of all this investment is a spike in the amount of plastic produced globally, as manufacturers in Asia and the Middle East ramp up their own production—with capacity increasing by more than a third in the next six years alone, according to an estimate from the Centre for International Environmental Law (CIEL). Most of this new plastic will be sent to developing countries with waste infrastructure ill-equipped to handle it. "If you're going to increase production of plastics—double it in the next 15 years—you're going to see an increase of unrecyclable plastic products and packaging going to the more remote parts of the world, where there is still no plan for efficient recovery," said Marcus Eriksen, a scientist and former Marine who co-founded the 5 Gyres Institute. Against this backdrop, investing $1 billion in trash collection is like trying to empty a bathtub with a teaspoon while the tap is on full blast. But plastic—and its fossil-fuel precursors—leaves a mark long before bags and bottles and Q-tips scatter across fields or wash into the oceans. Communities all along the supply chain will feel the impacts of the American plastics renaissance. What the industry describes as a bright new economic opportunity, others see as a looming disaster. "For too long, one of the most invisible aspects of the plastics crisis has been the impacts of plastics on communities who live in the shadows and along the fence line of plastics refining and manufacturing," said Carroll Muffett, CIEL's president and CEO. "These people are experiencing the impacts of our plastic planet in a way that is more immediate and more severe than just about anybody else in the world."

In the United States, the front of the plastics boom runs along the Gulf Coast from Texas to Louisiana, and through the upper Ohio River Valley, which spans Ohio, Pennsylvania, and West Virginia. It's made up of small communities that often had little say in their role in the new infrastructure build-out, with decisions made largely behind the scenes by politicians and corporate behemoths. Until recently, many people had no idea that their towns would soon become the knots connecting an immense plastic net thrown across the country. In May 2017, Donald Trump made his first overseas trip as president, to Saudi Arabia. He waved a sword

during a ceremonial dance, accepted lavish gifts—including a portrait of himself and a robe lined with white tiger fur—and signed a $110 billion arms agreement. Meanwhile, in a mint-and-gold-coloured room within the Saudi royal court, executives struck their own deals. Among them were Darren Woods, the CEO and chairman of ExxonMobil, and Yousef Al-Benyan, CEO of the Saudi Basic Industries Corporation (SABIC), one of the world's largest producers of petrochemicals. With Trump, Saudi King Salman, and then–US Secretary of State Rex Tillerson (a former Exxon CEO) looking on, Woods and Al-Benyan shook hands on a joint venture to build what will be the largest plastics facility of its kind, on Texas's Gulf Coast. Long before the deal was immortalised with glitzy photo ops, it was known as Project Yosemite—a code name designed to keep the initiative secret while its backers scouted sites. What the two companies wanted to build is known as a "cracker," a facility that uses heat and pressure to crack apart molecules of ethane gas so they can be reconfigured as ethylene and later polyethylene, the building block for a wide range of plastic products, from packaging to bottles. Once an unwanted by-product of oil and gas fracking, ethane flowing from Texas's Permian Basin and Eagle Ford Shale is now prompting a massive build-out of petrochemical infrastructure—pipelines, crackers, polyethylene plants, tanker terminals—along the Gulf Coast from St. James, Louisiana, to Corpus Christi, Texas. In 2016, with help from Texas Governor Greg Abbott, Exxon found a site for Project Yosemite on 1,400 acres of farmland north of Corpus Christi. By the time residents of two neighbouring towns learned of the massive project, county commissioners had already rezoned the farmland and were eagerly courting the oil giant. Soon Exxon was seeking $1 billion in tax breaks from the county and local school district. "That's when people woke up," said Errol Summerlin, a retired Legal Aid attorney who lives a few miles from the Exxon site, in the town of Portland. "Bingo. We started the battle then." A trim man with slightly stooped shoulders and a gravelly voice, Summerlin has lived in the same single-story white-brick house in Portland for 34 years. When I met him there in early January, he laid out a large map across his glass-topped dining table. With his finger, he traced the outline of Copano and Aransas bays to the north, where briny waters provide habitat to shrimp and oysters, redfish and black drum, roseate spoonbills and whooping cranes, and where billions of gallons of wastewater from the cracker will discharge. He pointed to an industrial corridor established in recent years on the north side of Corpus Christi Bay, where the flare from a natural-gas plant flickers incessantly. "That's Cheniere. You've got Sherwin Alumina, you've got Oxychem, Flint Hills…," he said, ticking off various industrial sites. Across the water, a narrow shipping channel runs like a vein along Refinery Row,

a corridor of round white storage tanks and towers that puff out columns of white and grey fumes. When Summerlin learned that hundreds of acres of farmland would be turned into an entirely new industrial zone for the cracker plant, he was disturbed. "Industry has been inching itself closer and closer to Portland," he explained. Plotted on a map, the rectangle of land where Exxon plans to build is nearly as large as Portland and about twice the size of neighbouring Gregory, a low-income, largely Hispanic community. While county officials and members of local business groups boasted of some 600 permanent jobs promised by Exxon, Summerlin worried about air and water pollution from the plant. According to Exxon's requested air permit, the facility will emit sulfur dioxide, volatile organic compounds, and nitrogen oxides, which can combine to form ozone smog; carcinogens, including benzene, formaldehyde, and butadiene; and other particulate matter. The health risks of these emissions include eye and throat irritation, respiratory problems, and headaches, as well as nose bleeds at low levels and, at high levels, more serious damage to vital organs and the central nervous system.

In late 2016, Summerlin and other concerned residents joined a newly formed group called Portland Citizens United, which sought initially to collect information about the proposed plant and later to try to stop the project, or at least convince Exxon to relocate to an area already given over to heavy industry. First, they challenged the rezoning, which had been done in violation of open-meeting laws. That set the project back a few months. The Portland City Council unanimously adopted a resolution opposing the site, on the grounds that it was too close to public schools—but because the site lies just outside city limits in unincorporated San Patricio County, the resolution amounted to a toothless plea. Now, the Texas Campaign for the Environment and the Sierra Club, working on behalf of Portland and Gregory residents, are contesting the air-quality permits that Exxon requested from the Texas Commission on Environmental Quality. Summerlin is not naive about the prospects of this effort: The commission is notoriously friendly to industry and, as far as Summerlin knows, has never denied a permit—certainly not to Exxon, one of the largest employers in the state. Nevertheless, Summerlin said, "I'm doing my best to slow the suckers down." We got into Summerlin's car and drove through Portland's sleepy neighbourhoods, past the high school and middle school, then hooked a left on the straight, flat road that runs next to the site. Once planted with cotton and sorghum, the plot is a weedy brown rectangle two miles long and a mile wide, ringed by a

tall wire fence and newly installed power lines. Summerlin drove slowly along the fence line, pointing to the outflow ditches where stormwater will be flushed out to the bays. In the fields stretching out to the north and east, a fleet of windmills stood at attention, arms spinning lazily. We passed a small pasture of Texas longhorns, which raised their heads to look at the car. Sandwiched between houses, with industrial smokestacks looming on the horizon, the cattle appeared lost. Further down the road, limp plastic bags dotted a fallow field of brown stalks like giant tufts of wet cotton. As Summerlin learned more about the facility, he grew increasingly alarmed by its scale and started to feel like the community had been misled. In addition to the steam cracker, which will produce 1.8 million tons of ethylene every year, Exxon and SABIC are building three units to make polyethylene and monoethylene glycol—which can be turned into antifreeze, latex paints, and polyester for clothing—as well as a rail yard where plastic pellets will be loaded onto trains bound for ocean ports and then shipped to Asia and Latin America. The facility needs a new road to transport components to build the plant, as well as a cargo dock and marine terminal. "They're all lauding this as a game changer—and it is, in a bad way," Summerlin said. "It transforms the whole area." Such infrastructure is just a small part of what oil and gas companies have planned for the Gulf Coast. Across Texas in recent years, more than 8,000 miles of pipeline have been laid down to carry oil, gas, and natural-gas liquids (which include ethane) from the Permian Basin and the Eagle Ford Shale to the coast, where dozens of new petrochemical projects are in the works. Exxon alone is planning to spend some $20 billion over a decade on its "Growing the Gulf" venture, a suite of petrochemical projects that includes the cracker outside Portland; another cracker at the company's chemicals complex in Baytown, near Houston; and an expansion of its plastics plant in nearby Beaumont. Other development is being driven by Congress's lifting, in 2015, of 40-year-old restrictions on crude-oil exports. With oil and natural-gas production surging, companies are eager to get their products overseas. Recently, the Port of Corpus Christi put forward plans to build new terminals for massive oil tankers, which raised hackles in Port Aransas, a beach town close to the proposed site that depends on tourism and fishing, both of which could be disrupted by ships nearly the length of four football fields coming and going. All of these new facilities will require water; Exxon's cracker alone will consume 20 to 25 million gallons per day, more than all the water currently used each day in San Patricio County's water district. But the area is prone to drought. The Port of Corpus Christi has plans to build a seawater-desalination plant on Harbor Island near Port Aransas, which could lead to discharges of extremely salty water back into the bays that serve as nurseries for

shrimp and fish. The development is also vulnerable to hurricanes. When Hurricane Harvey swept across Houston in 2017, many chemical plants shut down, releasing an estimated 1 million pounds of excess toxic emissions that drifted into neighbouring communities. But with little resistance from regulators, companies are plowing ahead with new development. Recently, the Port of Corpus Christi purchased 3,000 acres to the west of Portland, which Summerlin expects will be leased for other petrochemical projects. "We know what's going on," he said, "but nobody's telling us." A recent planning document showing the port's new tract of land listed code names for two new undisclosed proposals: Projects Falcon and Dynamo. About 80 miles up the coast from Portland in Point Comfort, tiny translucent pellets the size of lentils burrow into the muck and weeds at the edge of a sluggish creek. Further out, the pellets mingle with aquatic plants, floating together in whorls like confetti. Oystermen and anglers working in bays nearby find them inside oyster shells and in the guts of fish. Diane Wilson has been collecting these pellets for years. The "nurdles," as they're often called, have taken over her barn, which is stacked with bags of them, and 30 years of her life. A former commercial shrimper, Wilson is locked in a protracted battle against the source of the pellets: Formosa Plastics, a Taiwanese company that manufactures polypropylene, PVC, and other petrochemicals at a 2,500-acre complex along Cox Creek. In 1994, Wilson tried to sink her shrimp boat in a nearby bay to protest the chemical-laden wastewater discharges from the plant. Almost daily over the past four years, she and a handful of volunteers, some of them former Formosa employees, have gone out in kayaks and waders to collect evidence of the ongoing pollution. Although the US Environmental Protection Agency and the Texas Commission on Environmental Quality have fined Formosa repeatedly for various air- and water-quality violations, the nurdles continue to wash into the creek. Wilson is currently suing Formosa, asking a federal judge to fine the company $173 million and order an end to the dumping.

In Louisiana's St. James Parish, a majority-black community that spans the Mississippi River west of New Orleans, Formosa's plans to build a $9.4 billion plastics complex have drawn outrage from residents already hemmed in by dozens of chemical facilities and refineries. Cotton, sugar, and indigo plantations once lined the river; more recently, lifetime resident Sharon Lavigne remembers, her grandfather caught shrimp in the Mississippi River and picked figs and pecans from the trees in their yard. Now, St. James hosts more than a dozen industrial sites—part of

a corridor stretching from Baton Rouge to New Orleans that is often referred to as "Cancer Alley." Formerly designated for agricultural uses, the land for Formosa's new plant—which sits in a district that is more than 85 percent black—was redesignated as a "future industrial" zone in a planning document published in 2014, a decision that residents and environmental groups say was made with inadequate community input. A section of the planning document focused on the parish's history quotes a 1950s-era historical account that describes the early 1800s in St. James as an "era of fabulous plantation life" and "luxurious living," during which "acreage was counted by thousands and slaves by hundreds." Aside from demographic figures, that is the report's sole mention of the area's black communities. Anne Rolfes, founding director of the environmental-justice group Louisiana Bucket Brigade, called the planned development in the area one of "the most disgusting racial situations I've ever seen." Like many St. James residents, Lavigne can list a number of friends and relatives who have died from cancer or been sickened by respiratory conditions. After she learned about Formosa's plans to build yet another facility, Lavigne, a teacher who lives about a mile and a half from the proposed site, started a group called RISE St. James. At first, it consisted of 10 people meeting at her house. The group has since grown to a few dozen; they've held marches and shown up at public meetings to oppose Formosa and other plants. "We go to the meetings, we express our concerns, and people just look at us as though we're nothing," Lavigne told me. In December, activist Cherri Foytlin brought a permit hearing for the facility to a standstill when she told government officials, "You don't give a shit about brown and black people." A single mother of three who lives in St. James Parish because she can't afford a home closer to New Orleans told regulators, "I feel like I'm trapped. I feel like I don't have anywhere to go. I can't get away from the pollution. I'm surrounded by it." Two months later, the state approved one of Formosa's critical permits. For a long time, communities like St. James and people like Diane Wilson fought lonely battles against the petrochemical industry. The Break Free From Plastic movement, a coalition of more than 1,400 organizations, is working to connect these various localized struggles, from communities in West Texas impacted by fracking to neighbourhoods in the Philippines that are awash in plastic trash. Carroll Muffett of CIEL, which is a member of the coalition, said, "They realise they're all fighting different aspects of the same industry and the same problem." The story that the petrochemical industry tells about its products is not about pollution. It's a story of an innovation-driven manufacturing comeback, one that will create jobs at home and provide essential products to meet a growing demand overseas. "We are using new, abundant domestic-energy supplies to provide advantaged

products to the world," Exxon CEO Darren Woods said at a 2017 energy conference regarding the company's planned $20 billion investment in petrochemical infrastructure along the Gulf Coast. "The advent of plastics has benefited the world," Graham van't Hoff, executive vice president of Shell's chemicals division, wrote in January. Solar panels, wind turbines, and electric vehicles all use plastic components, he continued. The plastic products that account for the bulk of rising demand in developing countries, however, are not life-saving medical devices or specialised vehicle components. They aren't even really products in their own right. According to the International Energy Agency, "the single largest source of plastic demand" is packaging—the shrink-wrapping around a box of mushrooms, the tiny sachets containing a single wash of shampoo—much of it thrown away as soon as it is removed. This has historically been the plastic industry's profit model: "The future of plastics is in the trash can," Lloyd Stouffer, the editor of the trade journal Modern Packaging, declared in 1956. Now, according to the Ellen MacArthur Foundation, about a third of packaging ends up as trash. The environmental damage it causes and the greenhouse gases emitted during its production together cost some $40 billion annually—"exceeding the profit pool of the plastic packaging industry." The petrochemical industry sees this largely as the fault of waste-collection systems in poor countries. "I find the issue of unmanaged plastic waste deeply concerning," van't Hoff wrote in January. But, he added, "The challenge is not with plastics themselves. It is what happens after people use them. In some places, waste and recycling infrastructure is inadequate…. As a producer of petrochemicals and plastic resin, we cannot directly control the amount of plastic waste that gets into [the] environment."

Plastics producers have responded to growing public pressure by offering some support for clean-up efforts. "We believe we have a role in fixing it," said Steve Russell, vice president of plastics for the American Chemistry Council, which represents petrochemical companies, speaking of the plastic-waste crisis; he added that current funds for the industry's Alliance to End Plastic Waste are "a start point." But many environmental advocates see these efforts as greenwashing. Marcus Eriksen of the 5 Gyres Institute said that many of the solutions put forward by the industry require costly technology that will take years—if not decades—to scale. "They've been very effective in making the public think that recycling is key, and that it's the burden of the citizen, of the community, of the government to manage waste," Eriksen continued. "Globalization is still going to send unrecyclable materials to more remote parts of the world that can't employ the solutions that industry proposes, because they're

expensive." Environmental groups like those in the Break Free From Plastic movement are increasingly calling for a prevention-focused strategy, in which companies stop making materials designed to be used only once and pay the full cost of collecting and recycling plastic products. NGOs, academics, even the corporate consulting group McKinsey have embraced the concept of a "circular" plastics economy, in which products flow through a closed loop rather than "leaking" out. The circular model depends on improving the economics and technology of recycling and on fundamentally redesigning materials to replace single-use plastics with biodegradable or recyclable alternatives. A true circular model also requires reducing and eventually eliminating the amount of plastics created from fossil fuels—by developing alternative feedstocks from renewable sources, and by supplanting virgin feedstocks with recycled content. Running in the opposite direction are the major oil companies, who have placed big bets on their role as plastics producers. For oil giants like Exxon and Shell, plastics and other chemicals represent an increasingly significant source of profit—one that a circular-economy approach would threaten. "While increased recycling of plastics represents a gain in circular-economy terms, it is less good news for oil-resource-holding countries and oil companies, which will lose part of a source of future demand growth," McKinsey analysts wrote recently. According to the International Energy Agency, "petrochemicals are rapidly becoming the largest driver of global oil consumption," picking up the slack as efforts to curb emissions and increase efficiency limit other sources of demand. In 2015, while only 10 percent of Exxon's revenue came from its chemicals division, chemicals accounted for more than a quarter of its profits. As climate change forces a reckoning with fossil-fuel consumption, plastics offer another incentive to keep drilling. "Investing in chemicals is part of our strategy to thrive through the energy transition," wrote Shell's van't Hoff. The billions invested in new petrochemical infrastructure and local markets for ethane could help keep shale drillers—many of whom have been bleeding money—afloat. (According to the US Energy Information Administration, the high content of ethane and other natural-gas liquids in "many shale plays has made it economical for operators to continue to aggressively develop…shale gas resources during periods of low natural gas prices.") The boom in plastics "will perpetuate a fossil fuel economy that underpins both the climate crisis and the plastics crisis," concludes a 2017 CIEL report, "while impacting frontline communities and the wider public at every stage of its toxic lifecycle."

Early one morning last September, a gas pipeline near Terrie Baumgardner's home in western Pennsylvania exploded, turning the

sky the colour of dirty orange sherbet. Flames shot 150 feet into the air, destroying a house and sending several families scrambling to evacuate. Driving down the interstate days later, Baumgardner could make out a patch of scorched earth where the gas had burned itself out. Two days later, officials in the nearby township of Independence voted to repeal a rule mandating that pipelines be built at least 100 feet away from homes and 500 feet from parks, schools, and hospitals. Eliminating the ordinance eased the way for the Falcon Pipeline, a 97-mile project that will carry ethane from the Marcellus Shale to a new cracker being built by Shell on the banks of the Ohio River in Beaver County. To Baumgardner, a retired college instructor and member of a local non-profit called the Beaver County Marcellus Awareness Community, the elimination of the pipeline-setback rule was yet another example of state and local officials' rush to accommodate Shell. The cracker, slated to start operating in late 2021 or early 2022, will be the first to open outside the Gulf Coast in decades. But it's just one of several projects underway in the Ohio River Valley as corporations, state officials, and members of the Trump administration look to transform the region into a brand-new petrochemical corridor. A Thai company has proposed a cracker farther down the Ohio River in Belmont County, Ohio, and the industry and its political allies want to build a massive storage hub to hold as much as 100 million barrels of ethane and other natural-gas liquids beneath West Virginia, and possibly Pennsylvania and Ohio as well. The US Department of Energy is considering a $1.9 billion loan for that project, which Energy Secretary Rick Perry has described as a "once-in-a-lifetime opportunity for this country." To many people in northern Appalachia, petrochemicals look like the answer to the economic problems created by the collapse of steel and coal. Shell has helped drive that narrative, commissioning a study that predicted the cracker would produce $15 to $19 billion in regional economic activity in southwestern Pennsylvania over four decades. Although some economists have disputed the methodology that produced this rosy projection—for instance, it assumes that every job created at the plant will lead to 13 elsewhere, and omits the cost of a historic $1.65 billion tax break the state gave Shell—it was welcome news in Potter Township, where Shell is building its facility: 500 jobs there vanished when a zinc-smelting facility closed in 2014, leaving hundreds of acres contaminated with lead and arsenic. Shell promised to clean up the site and pledged hundreds of thousands of dollars for local historic-preservation projects. But to others, including Baumgardner, whatever economic benefits the cracker provides are far outweighed by the risks of large-scale petrochemical development. Pennsylvania has a long history of damage related to extractive industries, from the Donora smog of 1948, when a poisonous air

inversion killed 20 people and sent some 6,000 others to the hospital, to the fragmented disasters of fracking: toxic-waste ponds, ruined property values, lingering illnesses. "This area of the Ohio River Valley, and other areas that have had a lot of experience with resource extraction, they follow this boom-bust cycle. When you're in a bust phase and you lose jobs, there's a lot of momentum: 'Well, we need to attract industry to bring these jobs back,'" said Jennifer Baka, an energy geographer at Penn State. "We can't think outside of the box and think about what an alternative-energy future might be, because we're so familiar and accustomed to the existing fossil-fuel economy." Southwestern Pennsylvania suffers from some of the poorest air quality in the nation, according to Matthew Mehalik, the executive director of the Breathe Project, which works on air-pollution issues. "If you consider that backdrop—[that we] already have a serious air-quality problem—the potential to add more burden to our airshed will only make things worse," he added. One estimate puts the health-care impacts over a 30-year period from the Shell plant and two other crackers proposed in the region at $616 million to $1.4 billion in Beaver County alone, and up to $8.1 billion nationally. Critics of the projects also argue that regulators and communities are unprepared for the scale of development that is now underway. Lisa Graves-Marcucci, the Pennsylvania coordinator for the Environmental Integrity Project, is particularly worried about what she describes as "piecemeal, egg-slicer" permitting, in which projects like Shell's cracker are considered in isolation, obscuring the web of industrial infrastructure—drilling sites, compressor stations, storage hubs, pipelines—that goes along with them. Even some people in the industry have suggested that communities might not be fully aware of what's coming. "I think the magnitude of some of these projects that we're talking about here is hard for a lot of us and a lot of our communities to wrap their heads around," said Chad Riley, the CEO of the Thrasher Group, an engineering firm with projects in oil and gas fields, speaking at an industry conference in 2018 that was attended by reporter Sharon Kelly.

Ultimately, the fate of a facility that will affect the whole region was largely decided by three supervisors in tiny Potter Township, population 496. "Decisions have been made at higher levels of government, or sometimes in these small communities…that will forever change our region," Graves-Marcucci said. "Does that mean we've signed over our entire future to this constant need to drill more and frack more? Are we stuck on this treadmill of plastics?" Pennsylvania's northeastern neighbour has taken a different approach. New York banned fracking in 2014 and, a year later, unveiled a clean-energy initiative that established some of the most aggressive

energy-transition goals in the country. In 2018, Governor Andrew Cuomo announced a $1.5 billion investment in renewables projects across the state, with a goal of creating 40,000 clean-energy jobs by 2020. For a long time, Terrie Baumgardner didn't think much about what would come out of Shell's ethane cracker. Early on, she heard that the plant would produce plastic pellets, perhaps to fill stuffed animals. "But I don't think we realised at that point what a hazard plastic was for us and for the planet," she said. "It's only lately become a 'for what?' question—why are we doing this?" She continued: "Our leaders said, 'Here comes an industry and it can get people jobs.' And it was a backward-looking industry, but they didn't see it that way."

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https://www.thenation.com/

Nauru refugees exposed to asbestos after shipping containers dumped just metres away

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Refugees living on Nauru have been exposed to potentially deadly asbestos after workers dumped it next to a settlement on the Pacific Island.

Refugees living on Nauru have been exposed to potentially deadly asbestos after workers dumped it next to a settlement on the Pacific Island. Some refugees even used the dangerous material to build makeshift sheds, intensifying fears that many could develop life-threatening cancers within years. Large quantities of asbestos sheeting have been ripped off buildings by workers with Nauru Utilities Corporation. But videos and photos sent to the ABC show some asbestos was never safely disposed of. Instead, it was packed into shipping containers which were dumped only metres away from the Fly Camp settlement, where dozens of refugees live. Leaked minutes from a meeting between Nauru's Government and Australian officials show alarm bells started ringing about the asbestos in October last year. The documents said workers from the Brisbane construction firm Canstruct — which has been providing accommodation services to refugees on Nauru through an Australian Government contract — identified a "safety concern" when they spotted "asbestos placed at the back of Fly Camp". "There is a need to create awareness to our clients on the dangers of asbestos, as most of them are not aware of the danger," the document said. The minutes also said some of the refugees were "using the asbestos to build sheds, unaware of the dangers of using them" and that Canstruct workers had to take them down. Iranian refugee Ellie Shakiba — who left Nauru for the United States a few weeks ago — said she saw fragments of asbestos

littered all over the ground near Fly Camp, and large numbers of refugees would have been exposed. "There are containers of asbestos … and the doors are open. If you walk there then you are walking on asbestos," she said. "We haven't seen any trucks or anyone who is going to move it. [The Australian Government] knows about it, Canstruct knows about it, but nobody cares." Trevor Torrens from the Asbestos Disease Support Society said he could not independently verify if the material contained asbestos without testing a physical sample. But he said the minutes and the footage from Fly Camp were "deeply concerning". "Having it in an open area when potentially anyone could potentially use it, pick it up [or] use it for repairs to housing — it's just a dangerous situation," he said. "Once you start breaking up asbestos, it starts releasing fibres. It gets into the lungs, it stays in the lungs, it develops into a tumour. It will cause mesothelioma. It will eventually kill you," he said. "It's a recipe for disaster. Not now, but in many years to come … It should be removed immediately." A spokesperson from the Department of Home Affairs said the asbestos "does not belong to the Department or its contracted service providers and is not related to any regional processing activities." "The Department is aware of this matter and it has been raised with the Government of Nauru for appropriate action," the spokesperson said. "The Department and its service providers are working to educate residents about the dangers of the material and encourage them to keep away from it until it can be safely removed by the Government of Nauru." Ms Shakiba acknowledged that Canstruct stuff had warned Fly Camp residents to stay clear of the asbestos, but said some refugees had ignored the advice. And she accused contractors and officials from both the Australian Government and the Government of Nauru of endlessly passing the buck instead of simply removing the dangerous material. "ABF says this is not our responsibility, this is [up to] the Government of Nauru. Nauru says there is nothing we can do, you should ask Canstruct," she said. "There is no-one … who will take care of refugees or their requests or their problems." Asbestos has been widely used on Nauru. A report funded by the European Union warned that there were more than 200,000 square metres of asbestos-laden material on the island, with roofing and cladding "often 60-70 years old and in bad condition." In 2015 the ABC revealed that refugees and local workers on the island were removing asbestos from houses without proper protection. Ms Shakiba said refugees who worked to remove asbestos were almost certainly exposed to asbestos, and they should be flown to Australia immediately for health checks. "Nobody informed them at that time that these materials are dangerous, and you should be careful while working with them," she said.

Curiosities

ABC News, 19 March 2019

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

Five ways to make your home less toxic

2019-03-21

We are surrounded by chemicals – in food and drink, cleaning products, household items and furnishings. Here's how to reduce household pollution

Ventilate: Cleaning products, cooking, candles and building materials all contribute to pollution inside our homes. The British Lung Foundation (BLF) recommends choosing fragrance-free cleaning products and using solid or liquid products when possible, rather than sprays. It also advises opening windows or skylights, especially when cooking or showering, and avoiding the use of several candles or incense sticks in a small room such as a bathroom. As outdoor pollution can also travel into the home, the BLF also suggests keeping windows closed when Defra's Daily Air Quality Index is high.

We are surrounded by chemicals – in food and drink, cleaning products, household items and furnishings.

Cut down on plastic: The synthetic chemical Bisphenol A (BPA) is found in many plastic products and can be ingested or absorbed through skin contact, potentially disrupting the endocrine system. Ninety-five percent of adults are thought to have traces of BPA in their bodies through continuous exposure – Tamara Galloway, a professor of ecotoxicology at the University of Exeter, says avoiding heavily processed and packaged food can help to limit exposure. Breastfeeding or buying baby bottles with a BPA-free label are also among her recommendations.

Make your own cleaning products: The author of All You Need is Less: A Guilt-Free Guide to Eco-Friendly Living and Stress-Free Simplicity, Madeleine Somerville, says soap, baking soda and vinegar are all you need to make your own cleaning sprays. She recommends filling a spray bottle with hot water, leaving a few inches at the top, before adding a ¼ cup of white vinegar, 2 tbsp of eco-friendly washing-up liquid and an optional 1tbsp of borax.

Reduce dust and tackle any damp or mould: A 2016 US study identified 45 toxic chemicals in indoor dust, including phthalates, flame retardants and phenols. "Because indoor dust contains chemicals from a wide variety of products, it is like a parking lot for chemicals in the home," wrote Veena Singla, co-author of the study from the Natural Resources Defence Council

in California. Simple steps to reduce exposure include washing hands with plain soap and water, keeping household dust to a minimum by dusting with a damp cloth and using a vacuum with a high-efficiency particulate air (Hepa) filter. Damp and mould can also affect your immune system, as well as increase the chance of respiratory problems. Preventing the build-up of condensation is key, says the NHS, though mould must be removed carefully so as not to release spores.

Consider your paint choices: As well as the fumes and chemicals given out during painting, freshly decorated walls can continue to pollute long after they are dry. Paint labelled "ecofriendly" or "natural" due to its lowered levels of volatile organic compound (VOC) are not necessarily "green", wrote interior design journalist Katherine Sorrell. Among her recommendations are Edward Bulmer Natural Paint, Aglaia, Biofa, Earthborn and Ecos Organic Paints.

The Guardian, 18 March 2019

http://www.guardian.com

Scientists Warn 'Inactive' Ingredients in Drugs Are Not as Harmless as You'd Think

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The vast majority of oral medications contain ingredients that could cause adverse reactions in patients, new research suggests.

The vast majority of oral medications contain ingredients that could cause adverse reactions in patients, new research suggests. The culprits are so-called "inactive" ingredients: hundreds of thousands of different additives that help make up drugs but are not the medicine's main functional component. When a doctor hands you a prescription for a drug, the most important part of the medicine is what's called the API: the active pharmaceutical ingredient, the chemical intended to make you well. But the API isn't the only thing in the drugs people buy. Up to 99 percent of a pill or tablet can be made up of excipients: supposedly inert fillers that otherwise help the drug in terms of its appearance, consistency, colour, flavour, or other physical properties. Excipients, also known as bulking agents, are often listed as "inactive ingredients" on medication packaging, but that term is something of a misnomer. Unlike the API, excipients aren't supposed to have any direct therapeutic effect, which is why they're defined as "inactive", but that doesn't necessarily mean they're inactive or inert in other ways. "While we call these ingredients 'inactive,' in many cases, they are not," says gastroenterologist Giovanni Traverso from MIT and Brigham and Women's Hospital. "While the doses may be low, we

don't know what the threshold is for individuals to react in the majority of instances." Traverso was inspired to study inactive ingredients after being involved with a case five years ago in which a patient with coeliac disease reacted poorly to omeprazole, a drug used to treat stomach ulcers. The formulation taken by the patient contained ingredients derived from wheat products which may have included gluten. Those components could have been why the patient felt sick after taking the drug. "That really brought it home to me as far as how little we know about tablets and the potential adverse effects they might have," Traverso says. In the new study, Traverso and fellow researchers analysed the public database Pillbox, which contains information on over 42,000 oral medications marketed in the US, and more than 350,000 inactive ingredients that are used to make the drugs. On average, tablets or capsules contain 8.8 inactive ingredients, but hundreds have 20 or more, the researchers say, and sometimes over 30. About one-third of inactive ingredients only turn up once in the database, whereas others are common components (like magnesium stearate, which features in 72 percent of oral drugs). Usually, inactive ingredients make up over 50 percent of a pill, but sometimes it's as much as 99 percent, the team says. None of those statistics are necessarily problematic, but some of the data the team unearthed is more concerning. Specifically, 38 of the inactive ingredients identified by the team have been reported as causing allergic symptoms in the past, and 92.8 percent of all the oral medications in Pillbox contain at least one potential allergen, while 55 percent contain at least one FODMAP sugar. "For most patients, it doesn't matter if there's a little bit of lactose, a little bit of fructose, or some starch in there," explains one of the team, biochemical data scientist Daniel Reker from MIT. "However, there is a subpopulation of patients, currently of unknown size, that will be extremely sensitive to those and develop symptoms triggered by the inactive ingredients." The problem is compounded by the fact that while inactive ingredients are usually listed on packaging, their relative amount in the drug isn't detailed. Also, when doctors prescribe medicines to patients, they may only specify the dosage of API, not the formulation itself – and sometimes it's impossible to avoid certain inactive ingredients across multiple different formulations of a particular drug. The risks may be multiplied in terms of older patients too, given the elderly often take numerous drugs – potentially exposing them to a harmful build-up of inactive ingredients they might be sensitive to. "A patient taking 10 prescription medications would ingest an average of 2.8 grams of inactive ingredients daily," the authors write. "This is a substantial amount of excipient material that is administered to patients every day and merits further consideration." To sum up, there are numerous reasons why the team says more attention in the future needs to be paid to these

ingredients that so far have flown under the radar – and also to how they are regulated and given to patients. "Accounting for effects of excipients will enable advanced formulations for difficult-to-deliver medications and could lead to personalised medicine for vulnerable sub-populations," the authors explain in their paper. "Such analysis will empower clinicians to make conscious selections of formulations focusing on their patients' well-being." It's worth pointing out that three of the authors are listed as co-inventors on a provisional patent application for a system that uses algorithms to quantifying and detail inactive ingredients in medications. On the one hand, this means they might have a commercial interest in publicising the risks of inactive ingredients, which is something to bear in mind. But hopefully it also means the issues they've highlighted become easier to navigate one day, thanks to an app or website that can effectively explain just what we're buying at the pharmacy. "We were surprised by the results," Traverso told NBC News. "It involves almost every pill and capsule. And it's something we tend not to think about." The findings are reported in Science Translational Medicine.

Science Alert, 18 March 2019

http://www.sciencealert.com.au

Technical Notes

CHEMWATCH

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

ENVIRONMENTAL RESEARCH

Transformation of endocrine disrupting chemicals, pharmaceutical and personal care products during drinking water disinfection

Carbamazepine, triclocarban and triclosan biodegradation and the phylotypes and functional genes associated with xenobiotic degradation in four agricultural soils

Ioxynil and diethylstilbestrol disrupt vascular and heart development in zebrafish

Species sensitivity distributions for use in environmental protection, assessment and management of aquatic ecosystems for 12,386 chemicals

Characteristics of metal contamination in paddy soils from three industrial cities in South Korea

MEDICAL RESEARCH

Impact of chronic lead exposure on liver and kidney function and haematologic parameters

Biosafety evaluation of Janus Fe3O4-TiO2 nanoparticles in Sprague Dawley rats after intravenous injection

Complement regulatory protein CD59a plays a protective role in immune liver injury of trichloroethylene-sensitized BALB/c mice

Bradykinin contributes to immune liver injury via B2R receptor-mediated pathways in trichloroethylene sensitized mice: A role in Kupffer cell activation

Hepatic carboxylesterases are differentially regulated in PPARα-null mice treated with perfluorooctanoic acid

OCCUPATIONAL RESEARCH

Circulating microRNAs as potential biomarkers of occupational exposure to low dose organic solvents

Technical Notes

Chronic low dose exposure of hospital workers to ionizing radiation leads to increased micronuclei frequency and reduced antioxidants in their peripheral blood lymphocytes

High seroprevalence of hepatitis E virus in rabbit slaughterhouse workers

ECG conduction disturbances and ryanodine receptor expression levels in occupational lead exposure workers

Health care worker sensitivity to chlorhexidine-based hand hygiene solutions: A cross-sectional survey

PUBLIC HEALTH RESEARCH

Associations of blood levels of trace elements and heavy metals with metabolic syndrome in Chinese male adults with microRNA as mediators involved

Second-hand smoke exposure in adulthood and lower respiratory health during 20 year follow up in the European Community Respiratory Health Survey

Geographic and socio-economic variation in markers of indoor air pollution in Nepal: evidence from nationally-representative data

Low-cost photoionisation sensors as detectors in GC × GC systems designed for ambient VOC measurements

Early lead exposure and pubertal development in a Mexico City population