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

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Regulatory Update

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ASIA PACIFIC

Early regulatory changes affecting chemical importers and manufacturers

2019-04-18

The National Industrial Chemicals Notification and Assessment Scheme (NICNAS) has announced that early regulatory changes are now in effect. Whilst the new scheme will begin on 1 July 2020, early regulatory changes are now in effect under the current scheme. These changes will reduce regulatory burden for introducers of some lower risk chemicals such as polymers of low concern.

The following changes are now in effect:

- no more annual reporting for permit holders and self-assessed assessment certificate holders
- shorter timeframes for Approved Foreign Scheme assessments
- polymers of low concerns (PLCs) are exempt from notification
- expansion of the PLC criteria
- changes to the definition of a new synthetic polymer
- no more Safety Data Sheets (SDS) and labels required for cosmetics introduced at low volumes

The following is a summary of changes:

No annual reports for permits and self-assessed assessment certificates

Annual reports are not required to be submitted for the following permits and self-assessment certificates:

- commercial evaluation permits
- low volume permits
- controlled use permits
- self-assessment — PLCs (SAPLC)
- self-assessment — non-hazardous chemicals
- self-assessment — non-hazardous polymers.

Shorter time frames for Approved Foreign Scheme assessments

The time frame for assessments under the Approved Foreign Scheme category will be reduced from 90 days to 60 days. This applies to new chemical certificate applications under the current Approved Foreign Scheme categories for Limited and Standard certificates.

The National Industrial Chemicals Notification and Assessment Scheme (NICNAS) has announced that early regulatory changes are now in effect.

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Polymers of low concern are exempt from notification

PLCs can now be introduced without notification.

Find out more about PLC changes here

Expansion of the PLC criteria

New criteria for PLCs are now in effect. These new criteria mean more polymers will meet the definition of a PLC and thus a greater number will be exempt from notification. The changes to the PLC criteria are:

- removal of the molecular weight specification for polyesters
- addition of chemicals to the prescribed reactants list for polyesters
- alignment of molecular weight boundaries with those used in USA
- alignment of the moderate and high concern functional groups with those used in USA and Canada
- restrictions on perfluorinated polymers so they cannot be PLCs

Go to our revised PLC section for more information on PLC criteria

Use our online questionnaire to see if your polymer is a PLC

Change to synthetic polymer definition

The definition of new synthetic polymer has changed. References to 'at least 2%' in the current definition have been amended to read 'greater than 2%'. This provides greater international alignment with the USA and Canada.

A new synthetic polymer is now defined as a synthetic polymer:

- that includes a combination of monomers and other reactive components each representing greater than 2% by weight, being a combination not listed in the Inventory; or
- with a weight greater than 2% is attributable to a monomer or other reactive component that is not listed in the Inventory as a component of a synthetic polymer.

Removal of SDS and labelling requirements for exempt cosmetics

Safety Data Sheets and labels no longer have to be provided if the cosmetic is introduced under the 'no unreasonable risk' category in volumes greater than 10kg per annum.

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Further information is available at: Low volume cosmetics

NICNAS, 8 April 2019

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

Consultation: Proposed amendments to the Poisons Standard - ACCS, ACMS and Joint ACCS/ACMS meetings, June 2019

2019-04-18

On 11 April 2019, the Therapeutic Goods Administration published a proposed amendment to the Poisons Standard. The consultation is now open for public comment on scheduling proposals referred to the June 2019 meetings of the Advisory Committee on Medicines Scheduling (ACMS #27) and the Joint Advisory Committee on Medicines and Chemicals Scheduling (Joint ACMS-ACCS #22).

Submissions must be received by close of business 13 May 2019.

Proposed scheduling

To amend the finasteride entry in the Poisons Standard as follows:

Schedule 4 - Amend Entry

FINASTERIDE for human therapeutic use except when included in Schedule 3.

Schedule 3 - New Entry

FINASTERIDE for use in males with androgenetic alopecia (male pattern hair loss) in preparations containing not more than 1 mg per dose unit in packs not greater than 30 dosage units.

Appendix H - New Entry

FINASTERIDE

Index - Amend Entry

FINASTERIDE

Schedule 4

Schedule 3

Appendix H

On 11 April 2019, the Therapeutic Goods Administration published a proposed amendment to the Poisons Standard.

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Key uses / expected use

For the treatment of androgenetic alopecia (male patterned hair loss) in men over 18.

Reasons for proposal

Finasteride fulfils the criteria for a Schedule 3 substance and will provide an alternative to topical minoxidil for consumers. Consumers can easily identify the symptoms of male pattern hair loss and it can quite easily be verified by the pharmacist to ensure that there is no other reason for the hair loss. The product has been on the market for a number of years and pharmacists are well equipped to provide advice to consumers on the adverse effects, interactions and contraindications (in particular, the potential risk to the male foetus if finasteride is handled by pregnant women). The risk profile of the medicine is well defined and there are no identified drug interactions of clinical significance. There is little risk of misuse, abuse or illicit use as it does not have any effect outside of its use in hair loss or in larger doses for benign prostatic hyperplasia (BPH).

Proposed scheduling

To include 1,4-dimethylpentylamine (DMPA) DMP as a specific entry in the Poisons Standard as follows:

Schedule 10 - New Entry

1,4-DIMETHYLPENTYLAMINE (DMPA)

Index - New Entry

1,4-DIMETHYLPENTYLAMINE (DMPA)

Schedule 10

Index - Add cross reference

ALKYLAMINES WITH STIMULANT PROPERTIES - Amend Entry
cross reference: 1,3-dimethylbutylamine, DMBA, octodrine,
1-aminoisoeptane, DMHA, 1,5-dimethylhexylamine, 4methylhexane-2-
amine, 1,3-dimethylamylamine, DMAA, 4-amino-2-methylpentane citrate
(AMP citrate), 1,4-dimethylpentylamine, DMPA.

Schedule 10

Key uses / expected use

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An ingredient in sports supplements being used by athletes and members of the broader community as a stimulant before physical activity.

Reasons for proposal

This substance is currently captured under the Schedule 10 entry for alkylamines with stimulant properties due to its similarities to 1,3-dimethylamylamine (DMAA) and 1,3-dimethylbutylamine (DMBA). The new entry for DMPA is proposed in order to remove any potential ambiguity about the scheduling status of this substance. This would characterise DMPA as a substance of such danger to health as to warrant prohibition of sale, supply and use.

Proposed scheduling

To create a new entry for phenpromethamine in the Poisons Standard as follows:

Schedule 10 - New Entry

PHENPROMETHAMINE

Index - New Entry

PHENPROMETHAMINE

Schedule 10

Key uses / expected use

The substance is being used by athletes and members of the broader sporting community as a stimulant in so called 'pre-workout' sports supplements typically ingested before physical activity. Sports supplements found to contain phenpromethamine were marketed as providing a stimulant effect, to improve athletic performance, and to increase weight loss.

Reasons for proposal

Phenpromethamine is considered a primary analogue of methamphetamine (structural isomers) as per section 301.9 of the *Criminal Code Act 1995*. Phenpromethamine is a stimulant; it is chemically and structurally related to amphetamine, its derivatives (e.g. methamphetamine) and analogues. Phenpromethamine is a substance prohibited from sport by the World Anti-Doping Agency (WADA). Phenpromethamine is currently controlled by the German regulator Betäubungsmittelgesetz (BtMG) and is classified as Anlage I, non-tradeable

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substances available only by special permission of the authorities, which is granted for scientific or other public interest purposes.

Phenpromethamine has been reported to the Early Warning Advisory on New Psychoactive Substances of the United Nations Office on Drugs and Crime (UNODC).

Proposed scheduling

It has been proposed to amend the Poisons Standard as follows:

Schedule 10 - New Entry

SANGUINARINE for therapeutic use except in preparations containing 0.1 per cent or less.

Index - New Entry

SANGUINARINE

Schedule 10

Key uses / expected use

Alternative medicines

Reasons for proposal

Sanguinaria Canadensis (also known as 'bloodroot') is a key ingredient of black salve. Sanguinarine derived from the root of *Sanguinaria Canadensis* is used as an alternative treatment for cancer, including skin cancer. Sanguinarine leads to the indiscriminate death of normal and cancerous cells and results in extensive tissue necrosis and the formation of a thick black scab (eschar) which eventually sloughs off, leaving an open wound. Multiple case studies have shown that sanguinarine is not selective for tumour cells and that extensive tissue damage can result as well as a recurrence or metastasis of skin cancer. Sanguinarine has the potential to cause epidemic dropsy, a severe form of oedema that results from ingesting sanguinarine. Sanguinarine is in two listed medicines on the ARTG. There has never been a published controlled clinical trial conducted in black salve's 160-year history of clinical use.

Proposed scheduling

To include arbutin as a specific entry in the Poisons Standard as follows:

Schedule 4 - New Entry

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ARBUTIN in preparations for human therapeutic or cosmetic use except:

- when included in Schedule 2; or
- in hair preparations containing 0.75 per cent; or
- in cosmetic nail preparations containing 0.05 per cent; or
- in oral herbal preparations containing 500mg or less of arbutin per recommended daily dose.

Schedule 2 - New Entry

ARBUTIN in preparations for human external therapeutic or cosmetic use containing 5% or less of arbutin except:

- in hair preparations containing 0.75 per cent; or
- in cosmetic nail preparations containing 0.05 per cent

Index - New Entry/Amended entry

ARBUTIN

Schedule 4

Schedule 2

Key uses / expected use

Medicines and cosmetics

Reasons for proposal

- Commonplace and frequent population exposure to arbutin and hydroquinone via common dietary components at levels equal to likely levels arising from herbal exposure, combined with a lack of reports of adverse or toxic effects linked to naturally occurring arbutin, provides an established history of safety;
- available evidence shows that almost all hydroquinone released upon ingestion of arbutin is rapidly conjugated and eliminated with the urine;
- available evidence shows that the quantity of free, unconjugated hydroquinone released from arbutin *in vivo* is two orders of magnitude lower than the EMA permitted daily exposure (PDE) level for hydroquinone;
- naturally occurring arbutin in herbal medicines therefore does not present an unacceptable risk to human health.

How to respond

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- Submissions must be relevant to the proposed amendment;
- address matters mentioned in section 52E of the *Therapeutic Goods Act 1989*;
- include whether or not you support the amendment/s;
- Suggested improvements; and/or
- An assessment of how the proposed change will impact on you. That is, what do you see as the likely benefits or costs to you (these may be financial or non-financial). If possible, please attempt to quantify these costs and benefits.

What will happen

All public submissions will be published on the TGA website at Public submissions on scheduling matters, unless marked confidential or indicated otherwise in the submission cover sheet. Following consideration of public submissions received before the closing date and advice from the expert advisory committee/s, decisions on the proposed amendments will be published as interim decisions on the TGA website: Scheduling delegate's interim decisions & invitations for further comment on 12 September 2019.

TGA, 11 April 2019

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

China Works on VOC Limits for Inks

2019-04-18

According to the "Three –year Plan on Defending the Blue Sky", mandatory national standards specifying VOC limits of coating, ink, adhesives, detergents, etc. are required to be established by 2019 and key regions will take the lead in executing such standards from Jul 1, 2020. China's Standardization Administration (SAC) has announced on April 4th the project for formulating a new standard "Limits of volatile organic compounds (VOCs) in printing ink" on its website. As planned, it will be drafted by June of 2019 and formulated by the end of 2019. The standard will cover all types of ink products and promote industrial transformation and upgrading. Ink products need to conform to strict standards in order to make it to market. In addition, some organic solvents may be restricted to use as primary solvent/diluent components. Further information is available at:

- Three –year Plan on Defending the Blue Sky

According to the "Three –year Plan on Defending the Blue Sky", mandatory national standards specifying VOC limits of coating, ink, adhesives, detergents, etc.

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- Limits of volatile organic compounds (VOCs) in printing ink

Chemlinked, 11 April 2019

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

AMERICA

US EPA issues proposal for CBI substantiation

2019-04-18

The United States Environmental Protection Agency (EPA) has issued a proposed rule that would establish a procedure for confirming certain confidentiality claims under TSCA. The proposal, which was developed in accordance with the 2016 amendments to TSCA, relates to existing claims to protect as confidential business information (CBI) the specific chemical identity of an active substance. There are 7,757 active confidential substances, according to the 19 February update to the TSCA inventory. The EPA is required to put a final rule in place within one year of publishing its updated 'active-inactive inventory', outlining how companies must substantiate these claims. The agency then must complete reviews of that substantiation within five years, or by 19 February 2024. The procedure applies to companies that asserted a confidentiality claim during the 2017-18 inventory notification reporting process ('inventory reset') in a Notice of Activity (NOA) Form A submission. The EPA has proposed to exempt claims that have otherwise been substantiated in the past five years. But companies would still need to report and identify these past submissions to the agency.

Agency lays out plan for confirming substance identity protection claims under TSCA

Substantiation process

The EPA has proposed to require that all substantiation, or request for exemption, be filed electronically no later than 90 days after the final rule takes effect. The types of substantiation required to demonstrate the confidentiality claim include:

- demonstration that disclosure of the information would likely result in substantial competitive harm;
- steps the business has taken to protect the confidential information;
- outcomes of previous confidentiality determinations by the EPA, other federal agencies or a court; and
- a statement certifying the accuracy of the information.

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- The agency plans to review submissions – together with previously issued confidentiality determinations and other reasonably available information – to “determine the information’s entitlement to confidential treatment”.

Approved claims will be valid for a ten-year period. If, however, the EPA denies a claim, it would notify the submitter of its intent to disclose a chemical identity 30 days before doing so. Submitters could challenge a denial in court. For those claims that are not notified within the 90-day timeframe, the EPA is proposing to consider them “deficient” and to make those chemical identities public without further notice. The agency, however, has requested comment on the validity of this, particularly for those cases where a party may have substantiated the claim within the past five years but simply failed to notify them.

Review procedure

The EPA says it intends to complete its reviews by the 2024 deadline. It will set annual goals that “take into consideration this target completion date, the number of claims needing review and available resources.” And it said it may begin reviewing claims that were already voluntarily substantiated during the inventory reset process (subject to the outcome of pending litigation on that rule – see box), or for those substances that “appear to be clearly not entitled to protection from disclosure based upon other information,” even before the final rule takes effect. The agency plans to publish annual updates on its goals and completed reviews. Although there is the possibility of a two-year extension, it does not currently anticipate a need for it; however, “possible justifications” for an extension might include competing TSCA obligations or litigation over the process.

There will be a 60-day comment period on the proposed rule.

Outcome of CBI litigation looms

Even as the EPA’s CBI procedure takes shape, litigation is ongoing over its treatment of confidentiality under the amended TSCA.

The Environmental Defence Fund sued the agency over its inventory notification rule in 2017, alleging that the rule inappropriately allowed any person to maintain an existing confidentiality claim, regardless of whether they were the original claimant. The EPA has defended in court, however, that its interpretation of the statute was “reasonable”. Oral arguments in the case were heard last autumn, with a ruling possible before the year’s end.

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Further information is available at:

- Proposal (pre-publication)
- CBI of active chemicals
- Press release
- TSCA inventory

Chemical Watch, 11 April 2019

<http://chemicalwatch.com>

New PCB Regulations Coming Soon for Demolition Companies Operating in the San Francisco Bay Area

2019-04-18

New demolition regulations are coming soon for businesses involved with demolition activities in seven counties surrounding San Francisco Bay. Effective 1 July 2019, companies involved with the demolition of buildings constructed between 1950 and 1980 will face new regulations concerning polychlorinated biphenyls (PCBs) as part of the demolition permit application process. These new changes come from the Bay Area Stormwater Management Agencies Association (BASMAA) and its effort to prevent runoff from building demolition projects that could contain PCBs. These PCB-containing materials, found in some older buildings, may include some forms of caulking materials, pipe insulation, fiberglass insulation, adhesives and mastics. Other materials that may contain PCBs include fluorescent light ballasts and some old paints and specialty coatings. PCBs are manmade toxic chemicals that are no longer produced in the United States. Their use was discontinued in 1979 because the chemicals persist in the environment and can bioaccumulate in humans and animals. Their chemical structure allows them to remain for long periods of time cycling between air, water and soil. Exposure to PCBs has been demonstrated to cause a variety of adverse health effects on the immune, reproductive, nervous and endocrine systems. "The only way to know if old building materials contain PCBs is to have them tested," said Jeff Bannon, Vice President of Environmental Services at Clark Seif Clark (CSC). "The building science and environmental professionals at CSC offer PCB testing and monitoring from these materials and from environmental samples to assist companies in their screening and compliance efforts as part of the new regulations and permitting process."

Benzinga, 8 April 2019

<https://www.benzinga.com>

New demolition regulations are coming soon for businesses involved with demolition activities in seven counties surrounding San Francisco Bay.

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Brazil shelves chemicals bill 'until further notice'

2019-04-18

Brazil's environment minister has shelved the country's draft chemicals bill, according to a government source. The bill, which has been sitting with the Civil House since January, was awaiting review by the country's president, Jair Bolsonaro. However, Mr Bolsonaro, who took office on 1 January, has sent the bill back to his environment Minister Ricardo Salles, who has shelved it without review, the source says. All scheduled meetings of the working groups tasked with reviewing and shaping the draft bill for final approval have been cancelled "until further notice". Some Brazilian industry sources say that they have been dropped for the rest of the year.

OECD accession

The source says this "demonstrates that there is no intention to send the proposal back to the presidency, despite being informed about its importance under the OECD membership process". In 2017, Brazil applied to become a full OECD member country. It has not yet been invited to start the process of accession but if it is, the country will have to show its ability and willingness to implement the OECD council acts related to chemical safety. Brazil's bill, if adopted, would have addressed some of those council acts, such as the Decision-Recommendation on the Systematic Investigation of Existing Chemicals. However, the OECD would need to confirm this through a more in-depth evaluation during the accession process. The bill would establish a national chemicals register and technical committees for selecting substances and imposing regulatory measures.

UN funding

In December last year, UN Environment granted Brazil more than \$400,000 to help implement its chemicals bill, once adopted. This money will also be used on implementing the Basel, Rotterdam, Stockholm and Minamata Conventions, as well as activities under the UN's voluntary chemicals programme, the Strategic Approach to International Chemicals Management (Saicm). The funding, the source says, has not yet been received because the new government is reviewing the projects, agreements and acts, associated with the money. However, formal signing over of the funding is expected to happen soon. UN Environment has not called for a "review of the value or the objectives of the Project," the source said. In relation to implementing the BRS Conventions, "nothing has changed". However, MoE staff responsible for the conventions will not be attending the conferences of the Parties (COPs) to the Basel, Rotterdam

Brazil's environment minister has shelved the country's draft chemicals bill, according to a government source.

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and Stockholm conventions meetings later this month in Geneva. Nevertheless, despite shelving the chemicals bill, Brazil's draft Regulation on the control and use of hazardous substances in electrical and electronic equipment (EEE) will move ahead. It will be sent to the country's national environment council (Conama) for review "very soon", a government source told Chemical Watch. Further Information is available at: Chemicals Bill

Chemical Watch, 11 April 2019

<http://chemicalwatch.com>

EUROPE

ECHA, AskREACH trying to align SVHC databases

2019-04-18

The European Chemicals Agency (ECHA) and the pan-European AskREACH project are "working closely together" to reach a harmonisation of their two SVHC databases, the German Environment Agency (UBA) has said. The UBA addressed the overlap between the two projects in a workshop, *Compliance digital – Simplified corporate communication on SVHCs in articles*, in Berlin this week. Both ECHA and AskREACH are developing databases where companies feed in information on SVHCs in articles. The consumer and supplier awareness-focused AskREACH project was launched by the UBA and 19 project partners in September 2017. ECHA's database came out of the revised waste framework Directive (WFD) that entered into force in July. Although they will collect the same information, there are obstacles to joining up the two projects just yet, UBA's Ioannis Dosis told the workshop. ECHA can't tap into the information collected under AskREACH because it is legally tied under the WFD to build and operate its own database, he said. The two projects also serve different purposes, with AskREACH fostering consumer awareness and supply chain communication, and ECHA's project aimed at waste operators. In addition, they work to different timelines and use different identifiers for articles, as well as different formats for inputting the data, the UBA said. But Mr Dosis said the two parties are "working together closely" and "exploring opportunities for synergies" between their two databases. In any case, the consumer app that will be linked to the AskREACH database could become a "valuable add-on" for passing on information about SVHCs in articles to consumers, Mr Dosis said. And AskREACH will have access to the information held in ECHA's database.

The European Chemicals Agency (ECHA) and the pan-European AskREACH project are "working closely together" to reach a harmonisation of their two SVHC databases, the German Environment Agency (UBA) has said.

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Industry concerns

With both projects gearing up for different launch dates, however, industry is wary of being asked to submit information on their products twice and in different formats. This could discourage them from contributing to the voluntary AskREACH database and focus their resources on the mandatory ECHA database instead, workshop attendees said. Concerns at the meeting also centred on whether different players in the supply chain – from the manufacturer to the retailer – can input different information on the same article in the AskREACH database. One attendee put forward the possibility of only the manufacturer having the right to input data on an article, saying it would be “sensible if information is added at the earliest point possible in the supply chain”. Addressing fears that other actors in the supply chain could enter false information without the article manufacturer knowing, the UBA said the latter will be notified of any changes to their articles’ entries. And, it added, manufacturers will be encouraged to get involved in the project, by checking any information given by retailers.

Next steps

Companies can now take part in the project’s beta test phase and start filling up the AskREACH database, the UBA said in Berlin. The project is preparing to ‘soft launch’ the AskREACH app in June, with field testers visiting shops, scanning barcodes and sending SVHC information requests to the article suppliers. Besides testing the app, this should help article suppliers prepare for the rising number of consumer requests, the UBA says. The agency expects about 3m app downloads and 30m Article 33 requests to suppliers across Europe, by the time the project finishes in August 2022. The app will be fully launched in October, accompanied by consumer awareness raising campaigns that will run until early 2022. A supply chain communication tool for companies will also be launched in the autumn. ECHA, meanwhile, has until the end of the year to develop its SVHC database. Further Information is available at:

- Workshop agenda
- AskREACH

Chemical Watch, 11 April 2019

<http://chemicalwatch.com>

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Is the Commission's Better Regulation Agenda making EU regulation better?

2019-04-18

The Better Regulation Agenda is regarded by authors as a step forward for the EU to become a leading example of good regulatory governance worldwide. The great majority of the authors who have analysed the Commission's Better Regulation Agenda welcome the ambition of the reforms and see them as further strengthening the EU's regulatory system. The Better Regulation Agenda is regarded by authors as a step forward for the EU in closing the policy cycle and becoming a leading example of good regulatory governance worldwide. A commitment to evidence-informed policy making and evaluation, an increased responsiveness to stakeholders, a greater role of scrutiny, transparency and consideration for subsidiarity are highlighted as positive outcomes of the Commission's Better Regulation Agenda. Many authors recognise that the Better Regulation Agenda attempts to address the most relevant criticism and the difficulties encountered in the past. These are some of the main findings of a fresh JRC analysis on the papers published in peer-reviewed journals and literature on the Commission's Better Regulation Agenda.

The Better Regulation Agenda responds to past criticism

Responding to the concerns of citizens and businesses about lack of transparency in EU decision-making, the European Commission launched the Better Regulation Agenda in 2015. It is a comprehensive set of reforms covering the entire policy cycle. The reforms aim to ensure that policy-making is priority-driven, evidence-informed, transparent and effective. The Agenda intends to boost openness and transparency in the EU decision-making process, improve the quality of new laws and promote consistent review of existing EU laws so that they achieve their objectives in the most effective and efficient way.

Commitment to evidence-informed policy-making is a step forward

The authors welcome the European Commission's commitment to evidence-informed policy-making in all policy making activities. The attempt to provide practical and coherent guidance via the Better Regulation guidelines and toolbox is also seen as a positive sign, as well as the consideration of both qualitative and quantitative approaches. Some authors also note, however, that the rich toolbox still allows for a variety of practices and that a consolidated methodological framework and appropriate standards to select and weigh evidence could be beneficial.

The Better Regulation Agenda is regarded by authors as a step forward for the EU to become a leading example of good regulatory governance worldwide.

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The Better Regulation Agenda has led to stronger stakeholder involvement

The literature recognises that the Better Regulation Agenda strengthens stakeholder involvement, commitments and their implementation. Consultation has been extended to more types of EU legislation and to every stage of the policy cycle. This process provides the opportunity for new information to be gathered by the EC, contributing to better insights into stakeholders' positions. As a potential point for improvement, some authors observe that current procedures generate a high workload on stakeholders and the EC itself, and that participation in consultations is often confined to the actors already having access to the political process.

More transparency in EU policy making

The literature recognises that the Better Regulation Agenda strives to open up EU policy-making for public participation, and thus make the EU more transparent and accountable. However, it is also highlighted that further improvement is needed. For example, some authors claim that it is not easy to obtain a complete picture of all ongoing and completed EU evaluations, and that the access to original studies is sometimes difficult. Some authors propose that EU institutions and EU Member States commit to providing information throughout the whole policy cycle. Some reviews underline the importance of more widely communicating actions taken within the Better Regulation framework, and of developing a renewed narrative which highlights the benefits of EU regulation. They also acknowledge that success of the Better Regulation depends, ultimately, on effective and constructive co-operation from all of the actors participating in and benefitting from policy-making.

JRC study support's Commission's stocktaking on Better Regulation approach

The JRC study was carried out in support of the Stocktaking of the Commission's 'Better Regulation' Approach. It is used in Staff Working Document SWD (2019) 156, and in Communication COM (2019) 178. As the science and knowledge service of the Commission, JRC supports the Better Regulation approach by providing independent evidence throughout the policy cycle.

Conference "Better regulation: taking stock and sustaining our commitment"

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CHEMWATCH

On 29 April 2019, the European Commission is holding a conference in Brussels to discuss the results of the better regulation stocktaking exercise, exchange views on possible ways forward and further build the community of better regulation practitioners.

EU Joint Research Centre, 16 April 2019

<http://ec.europa.eu/dgs/jrc/index.cfm>

List of compliant notifications for inclusion in the BPR Review Programme updated

2019-04-18

On 5 April 2019, the European Chemicals Agency (ECHA) updated the list of those active substance/product-type combinations for which a compliant notification for inclusion in the BPR Review Programme has been made. The following substances were updated:

- Formic acid
- Performic acid generated from formic acid and hydrogen peroxide
- Active chlorine generated from hydrochloric acid by electrolysis

Yorda's Hive, 10 April 2019

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

Swedish Chemicals Products Ordinance amended

2019-04-18

On 3 April 2019, SFS 2019:173 was published, amending the Swedish Chemicals Products Ordinance. The following substance was added:

- Ammonium carbonate

Yorda's Hive, 10 April 2019

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

On 5 April 2019, the European Chemicals Agency (ECHA) updated the list of those active substance/product-type combinations for which a compliant notification for inclusion in the BPR Review Programme has been made.

REACH Update

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Registered substances mapped for regulatory action

2019-04-19

The first report of the Integrated Regulatory Strategy presents a mapping of the universe of registered substances that are on the EU market. This information helps authorities to identify, plan and monitor the progress on identifying and regulating substances of concern. The report visualises the work that the European Chemicals Agency (ECHA) and the Member States have done to transform the vast data generated under REACH into knowledge on which substances need further hazard information, further risk management measures or for which substances authorities can conclude that they are not a priority at the moment. "Our work enables authorities to focus on activities that improve human health and the environment in Europe and make the European industry more competitive. We remind industry to further improve the compliance of their registration information, in particular for substances with a high potential for exposure and for which hazard data is currently lacking," states ECHA's Executive Director Bjorn Hansen. Within the report, registered substances are divided into three main pools:

- High priority for risk management, covering around 270 substances. These are substances with an identified concern and for which further regulatory work is ongoing or can start based on currently available information.
- High priority for data generation and assessment, with around 1 300 substances of potential concern. Here further data needs to be generated or assessed to enable authorities to decide whether further regulatory risk management is needed.
- Low priority for further regulatory action at present. In this group, around 450 substances are considered as already sufficiently regulated and almost 500 substances have been concluded as low priority after assessment.

Currently, the focus is on the 4 700 substances registered above 100 tonnes. We have allocated already more than 40 % of these substances to the above pools of substances. The list of the substances will be published at the end of the year on ECHA website and will be updated as the work progresses. However, authorities still need to clarify in which pool the remaining 2 700 substances belong. This uncertain area is what is left after more than 10 years of systematic screening, focusing on substances of high concern. ECHA foresees that a significant number of them will undergo compliance checks or substance evaluation in the coming years to generate the necessary information for priority setting and assessment.

The first report of the Integrated Regulatory Strategy presents a mapping of the universe of registered substances that are on the EU market.

REACH Update

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Authorities need to speed up work on this uncertain area and to shorten the time between identifying a concern and initiating risk management measures. In particular, action to harmonise the classification or action under other legislation should be taken faster. Further information is available at:

- [Report: mapping the universe of registered substances to address substances of concern](#)
- [Addressing substances of concern](#)

ECHA, 17 April 2019

<http://echa.europa.eu>

Two restriction dossiers submitted

2019-04-19

On 12 April, the following restriction dossiers were submitted:

- A proposal by France and Sweden to restrict skin sensitising, irritative and/or corrosive substances (EC/CAS -).
- A proposal by Norway to restrict perfluorohexane-1-sulphonic acid, its salts and related substances.

ECHA's committees are currently performing a conformity check on the reports. ECHA will publish the reports on its website to ensure transparency and to help stakeholders prepare for the six-month public consultations on the reports. The public consultations are expected in June 2019 if the reports pass conformity. Further information is available at: [Registry of restriction intentions until outcome](#)

ECHA News, 17 April 2019

<http://echa.europa.eu>

New substance evaluation conclusion published

2019-04-19

The European Chemicals Agency (ECHA) have published a new substance evaluation conclusion document on its website. The new substance evaluation is for imidazole (EC 206-019-2, CAS 288-32-4), which was added to the CoRAP list in 2012 and evaluated by United Kingdom. Further information is available at:

- [Community rolling action plan](#)

The European Chemicals Agency (ECHA) have published a new substance evaluation conclusion document on its website.

REACH Update

CHEMWATCH

- Substance evaluation

ECHA News, 17 April 2019

<http://echa.europa.eu>

New Interact Portal for authorities coming soon

2019-04-19

The European Chemicals Agency's (ECHA) Interact Portal will provide a single point of access for Member State authorities, ECHA's committees and the Agency. The portal will provide users with easy access to useful information and to tools relevant for their work, such as REACH-IT, R4BP, ePIC and IUCLID. Through the Interact portal, members of ECHA's scientific committees, advisers and rapporteurs will also be able to access the Collaboration tool for the joint preparation of documents. The Interact Portal replaces the previous Portal Dashboards for Member State competent authorities and national enforcement authorities.

ECHA News, 17 April 2019

<http://echa.europa.eu>

Public consultations on harmonised classification and labelling

2019-04-19

The European Chemicals Agency (ECHA) is looking for comments on the harmonised classification and labelling proposals for 2 new substances. The new substances are:

- Pendimethalin (ISO); N-(1-ethylpropyl)-2,6-dinitro-3,4-xylidine (EC 254-938-2, CAS 40487-42-1). The substance has an existing harmonised classification and labelling in Annex VI to CLP. Comments are invited on the hazard classes skin sensitisation, reproductive toxicity and hazardous to the aquatic environment.
- Ammonium bromide (EC 235-183-8, CAS 12124-97-9). The substance has no existing harmonised classification and labelling in Annex VI to CLP. Comments are invited on all health hazard classes except respiratory sensitisation and aspiration hazard.

The European Chemicals Agency's (ECHA) Interact Portal will provide a single point of access for Member State authorities, ECHA's committees and the Agency.

REACH Update

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The deadline for comments is 14 June 2019. To submit comments, go to:

[Give comments](#)

ECHA News, 17 April 2019

<http://echa.europa.eu>

New poison centre terms added to ECHA-term

2019-04-19

Sixty new terms and their definitions can now be found in ECHA-term in 23 EU languages. The majority of the new terms and abbreviations are related to poison centre activities. ECHA-term is a multilingual terminology database supporting your work in 23 EU languages. You can look up terms and their definitions in different languages as well as download them free of charge. Further information is available at: [ECHA-term](#)

ECHA News, 17 April 2019

<http://echa.europa.eu>

List of Review Programme notifications updated

2019-04-19

An updated list of the substance and product-type combinations for which compliant notifications for inclusion in the Review Programme have been made is now available. The names of the notifying companies have been included to promote collaboration on applications and to help avoid unnecessary testing on animals. The updated list is available at: [List of notifications](#)

ECHA News, 17 April 2019

<http://echa.europa.eu>

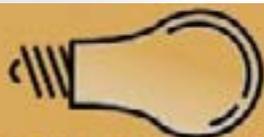
Sixty new terms and their definitions can now be found in ECHA-term in 23 EU languages.

Janet's Corner

CHEMWATCH

How Many Physical Chemists Does It Take To Change A Light Bulb?

2019-04-19



Q: How many physical chemists does it take to change a light bulb?

A: Only one, but he'll change it three times, plot a straight line through the data, and then extrapolate to zero concentration.

Hazard Alert

CHEMWATCH

Hydrogen Peroxide

2019-04-01

Hydrogen peroxide is a chemical compound with the formula H_2O_2 . [1] It is a colourless liquid at room temperature with a bitter taste. Small amounts of gaseous hydrogen peroxide occur naturally in the air. It is unstable, decomposing readily to oxygen and water with release of heat. Although non-flammable, it is a powerful oxidising agent that can cause spontaneous combustion when it comes in contact with organic material. [2]

USES [1]

Industrial

- Hydrogen peroxide is used for pulp- and paper-bleaching.
- It is also used in the manufacture of sodium percarbonate and sodium perborate, which are used as mild bleaches in laundry detergents.
- Hydrogen peroxide is used in the production of various organic peroxides including dibenzoyl peroxide, which are used as a flour bleaching agent and as a treatment for acne.
- Peroxy acids, such as peracetic acid and meta-chloroperoxybenzoic acid are also typically produced using hydrogen peroxide.
- Hydrogen peroxide is used in certain waste-water treatment processes to remove organic impurities.

Medical

Disinfectant

- Hydrogen peroxide can be used for the sterilisation of various surfaces, including surgical tools and may be deployed as a vapour (VHP) for room sterilisation.
- Historically hydrogen peroxide was used for disinfecting wounds. It is now thought to slow healing and lead to scarring because it destroys newly formed skin cells.

Cosmetic applications

- Diluted hydrogen peroxide (between 1.9% and 12%) mixed with ammonium hydroxide is used to bleach human hair.
- Hydrogen peroxide is also used for tooth whitening and can be mixed with baking soda and salt to make a home-made toothpaste.

Hydrogen peroxide is a chemical compound with the formula H_2O_2 .

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- Hydrogen peroxide may be used to treat acne, although benzoyl peroxide is a more common treatment.

Propellant

Hydrogen peroxide is a component of rocket fuel.

Explosives

Hydrogen peroxide has been used for creating organic peroxide-based explosives, such as acetone peroxide, for improvised explosive devices.

Other uses

- Glow sticks: Hydrogen peroxide reacts with certain di-esters, such as phenyl oxalate ester (cyalume), to produce chemiluminescence; this application is most commonly encountered in the form of glow sticks.

Horticulture

Some horticulturalists and users of hydroponics advocate the use of weak hydrogen peroxide solution in watering solutions. Its spontaneous decomposition releases oxygen that enhances a plant's root development and helps to treat root rot (cellular root death due to lack of oxygen) and a variety of other pests.

Fish aeration

Laboratory tests conducted by fish culturists in recent years have demonstrated that common household hydrogen peroxide can be used safely to provide oxygen for small fish. The hydrogen peroxide releases oxygen by decomposition when it is exposed to catalysts such as manganese

SOURCES & ROUTES OF EXPOSURE

Sources of Exposure [2]

- You can be exposed to hydrogen peroxide through its use as a general disinfectant. Hydrogen peroxide solutions used for this purpose are sold at almost all drugstores or supermarkets.
- Because hydrogen peroxide is used in many industries for a variety of purposes, workers in such industries may be exposed to this chemical through inhalation or contact with the skin.

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Routes of Exposure [3]

- **Inhalation:** Inhalation of vapours, mists, or aerosols from concentrated solutions of hydrogen peroxide can cause significant morbidity. Because it is nearly odourless and non-irritating except at high concentrations, persons may not be aware of its presence.
- **Skin/Eye Contact:** Hydrogen peroxide is poorly absorbed through intact skin. When used for household disinfectant purposes (3% to 5%), it is mildly irritating to the skin and mucous membranes. At a concentration of 10%, which is found in some hair-bleaching solutions, it is strongly irritating and may be corrosive.
- **Ingestion:** If ingested, solutions of hydrogen peroxide up to concentrations of 9% are generally nontoxic; however, even a 3% solution is mildly irritating to mucosal tissue and may cause vomiting and diarrhoea. Ingestion of industrial-strength solutions causes systemic toxicity and has been associated with fatalities.

HEALTH EFFECTS [2]

- Hydrogen peroxide can be toxic if ingested, inhaled, or by contact with the skin or eyes.
- Inhalation of household strength hydrogen peroxide (3%) can cause respiratory irritation.
- Exposure to household strength hydrogen peroxide can cause mild ocular irritation.
- Inhalation of vapours from concentrated (higher than 10%) solutions may result in severe pulmonary irritation.
- Ingestion of dilute solutions of hydrogen peroxide may result in vomiting, mild gastrointestinal irritation, gastric distension, and on rare occasions, gastrointestinal erosions or embolism (blockage of blood vessels by air bubbles). Ingestion of solutions of 10-20% strength produces similar symptoms, but exposed tissues may also be burned. Ingestion of even more concentrated solutions, in addition to the above, may also induce rapid loss of consciousness followed by respiratory paralysis.
- Eye exposure to 3% hydrogen peroxide may result in pain and irritation, but severe injury is rare. More concentrated solution may result in ulceration or perforation of the cornea.
- Skin contact can cause irritation and temporary bleaching of the skin and hair. Contact with concentrated solutions may cause severe skin burns with blisters.

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- It is unknown whether hydrogen peroxide affects in humans.

SAFETY [4]

First Aid Measures

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

Fire & Explosion Information

- Hydrogen peroxide is non-flammable;
- It is slightly explosive in presence of open flames and sparks, of heat, of organic materials, of metals, of acids.
- Small fires should be extinguished with water. Do not use dry chemicals or foams. CO₂, or Halon may provide limited control.
- Large fires should be extinguished with water from a distance. Move containers from fire area if you can do it without risk. Do not move cargo or vehicle if cargo has been exposed to heat. Fight fire from

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maximum distance or use unmanned hose holders or monitor nozzles. Cool containers with flooding quantities of water until well after fire is out. ALWAYS stay away from tanks engulfed in fire.

- For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn.
- Hydrogen Peroxide is a strong oxidiser. It is not flammable itself, but it can cause spontaneous combustion of flammable materials and continued support of the combustion because it liberates oxygen as it decomposes.
- Hydrogen peroxide mixed with magnesium and a trace of magnesium dioxide will ignite immediately.
- Soluble fuels (acetone, ethanol, glycerol) will detonate on a mixture with peroxide over 30% concentration, the violence increasing with concentration.
- Explosive with acetic acid, acetic anhydride, acetone, alcohols, carboxylic acids, nitrogen containing bases, As_2S_3 , $Cl_2 + KOH$, FeS , $FeSO_4 + 2$ methylpyridine + H_2SO_4 , nitric acid, potassium permanganate, P_2O_5 , H_2Se , Alcohols + H_2SO_4 , Alcohols + tin chloride, antimony trisulfide, chlorosulfonic acid, aromatic hydrocarbons + trifluoroacetic acid, azelaic acid + sulfuric acid (above 45 C), benzenesulfonic anhydride, tert-butanol + sulfuric acid, hydrazine, Sulfuric acid, Sodium iodate, tetrahydrothiophene, thiodiglycol, mercurous oxide, mercuric oxide, lead dioxide, lead oxide, manganese dioxide, lead sulfide, gallium + HCl, ketenes + nitric acid, Iron (II) sulfate + 2-methylpyridine + sulfuric acid, Iron (II) sulfate + nitric acid, + sodium carboxymethylcellulose (when evaporated), Vinyl acetate, trioxane, water + oxygenated compounds (eg: acetaldehyde, acetic acid, acetone, ethanol, formaldehyde, formic acid, methanol, 2-propanol, propionaldehyde), organic compounds. Beware: Many mixtures of hydrogen peroxide and organic materials may not explode upon contact. However, the resulting combination is detonatable either upon catching fire or by impact.
- Explosion hazard is severe when highly concentrated or pure hydrogen peroxide is exposed to heat. Mechanical impact or caused to decompose catalytically by metals and their salts, dusts and alkalis.
- Another source of hydrogen peroxide explosions is from sealing the materials in strong containers.

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Exposure Controls & Personal Protective Equipment

Engineering Controls

- Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapours below their respective threshold limit value.
- Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protective Equipment

The following personal protective equipment is recommended when handling hydrogen peroxide:

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

Personal Protection in Case of a Large Spill:

- Splash goggles;
- Full suit;
- Vapour respirator;
- Boots;
- Gloves;
- A self-contained breathing apparatus should be used to avoid inhalation of the product.
- Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

REGULATION

United States

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

- General Industry: 29 CFR 1910.1000 Table Z-1 -- 1 ppm, 1.4 mg/m³ TWA
- Construction Industry: 29 CFR 1926.55 Appendix A -- 1 ppm, 1.4 mg/m³ TWA

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- Maritime: 29 CFR 1915.1000 Table Z-Shipyards -- 1 ppm, 1.4 mg/m³ TWA

ACGIH: The American Conference of Governmental Industrial Hygienists has set a Threshold Limit Value (TLV) for hydrogen peroxide of 1 ppm, 1.4 mg/m³ TWA; Appendix A3 - Confirmed Animal Carcinogen with Unknown Relevance to Humans

NIOSH: The National Institute for Occupational Safety and Health has set a Recommended Exposure Limit (REL) for hydrogen peroxide of 1 ppm, 1.4 mg/m³ TWA

Australia

Safe Work Australia: Safe Work Australia has set a Time Weighted Average Concentration (TWA) for hydrogen peroxide of 1 ppm or 1.4 mg/m³ for a 40-hour work week.

REFERENCES

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4. <http://www.sciencelab.com/msds.php?msdsId=9924299>
5. https://www.osha.gov/dts/chemicalsampling/data/CH_246600.html
6. <http://www.safeworkaustralia.gov.au/sites/SWA/about/Publications/Documents/772/Workplace-exposure-standards-airborne-contaminants.pdf>

Gossip

CHEMWATCH

Making xylitol and cellulose nanofibers from paper paste

2019-04-03

The ecological bio-production of xylitol and cellulose nanofibers using modified yeast cells, from material produced by the paper industry has been achieved by a Japanese research team. This discovery could contribute to the development of a greener and more sustainable society. The findings were published on 4 March, in Green Chemistry. The research was carried out by a group led by Assistant Professor Gregory Guirimand-Tanaka, Professor Tomohisa Hasunuma and Professor Akihiko Kondo from the Graduate School of Science, Technology and Innovation and the Engineering Biology Research Centre of Kobe University. In his effort to develop innovative processes to achieve a sustainable society, Professor Kondo has focused on a variety of bio-compounds such as xylitol, a highly valuable commodity chemical, which is widely used in both the food and pharmaceutical industries (for example, as a sugar substitute in chewing gum). Professor Kondo's group is also interested in innovative nanomaterials such as cellulose nanofibers, which present huge economic potential due to the properties of nanocellulose (mechanical properties, film-forming properties, viscosity etc.), and significant applications in food, hygiene, absorbent, medical, cosmetic and pharmaceutical products. The worldwide demand for both xylitol and cellulose nanofibers is constantly growing, and the cost and environmental impact of their industrial production remain very high. The industrial production of xylitol and cellulose nanofibers from purified D-xylose and cellulose fibres respectively involve costly and polluting processes. In order to solve these issues and realise a sustainable and environmentally-conscious society, we must make use of renewable biomass such as paper paste (Kraft pulp) and develop innovative processes. Biotechnological production of xylitol and cellulose nanofibers using Kraft pulp, deriving from the paper industry, could be an advantageous option, as this material is abundant, contains reasonable amounts (17%) of D-xylose, and can be converted into highly valuable commodity compounds and nanomaterials. To release the D-xylose contained in Kraft pulp, we usually need to add a large amount of commercial enzymes (CE), which are very costly. Therefore, we decided to use microorganisms such as modified yeast, which is capable of producing these enzymes by itself, in order to reduce the amount of CE initially required. The modified yeast cells developed are carrying these enzymes directly on their own cell surface, and we call this strategy "cell surface display" technology. In this study, xylitol and cellulose nanofibers

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were co-produced from Kraft pulp by using a modified strain of baker's yeast (*Saccharomyces cerevisiae* YPH499 strain) expressing three different enzymes (β -D-glucosidase (BGL), xylosidase (XYL) and xylanase (XYN)) co-displayed on the cell surface. By using this strategy, we were not only able to produce xylitol and cellulose nanofibers, but also to considerably increase the purity of the cellulose itself and the cost efficiency of the process by reducing the amount of CE initially required. Last but not least, our team was able to successfully perform these experiments in larger volumes by using 2-litre jar fermenters, enabling us to further scale up bio-refinery industrial production of xylitol and cellulose nanofibers from Kraft pulp. Based on these findings, the team will continue to look for ways to increase the sustainable bio-production of xylitol and cellulose nanofibers through genetic engineering of yeast cells.

Science Daily, 19 March 2019

<http://www.sciencedaily.com>

Making solar cells is like buttering bread

2019-04-03

Formamidinium lead iodide is a very good material for photovoltaic cells, but getting the correct and stable crystal structure is a challenge. The techniques developed so far have produced rather poor results. However, University of Groningen scientists, led by Professor of Photophysics and Optoelectronics Maria Antonietta Loi, have now cracked it - using a blade and a dipping solution. The results were published in the journal *Nanoscale* on 15 March 2019. Formamidinium lead iodide (FAPbI₃) is a perovskite, a crystal with a distinctive structure. Perovskites are named after a mineral that has the chemical formula ABX₃. In an idealised cubic unit cell, the X position is occupied by anions that form an octahedron with a central cation in the B position while the corners of the cube are occupied by the A position cations.

Industrial production

'This formamidinium lead iodide material has very good characteristics, but the A position formamidinium ion causes instability in the structure,' explains Loi. 3D films made from this material most often turn out to be

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a mixture of a photoactive and a photoinactive phase, the latter being detrimental to the final application. Loi therefore set her PhD student Sampson Adjokatse to work to find a solution. After trying different strategies, he found one that worked. 'And most importantly, one that is scalable and could be used for industrial production,' says Loi. After all, solar cells must be produced in large panels and it is very important to find a good and cheap technique to do so. Adjokatse started with a different perovskite, in which the formamidinium was replaced by a larger 2 phenylethylammonium molecule, and in doing so formed a 2D perovskite. This material was deposited as a thin film using the 'doctor-blade' technique, related to techniques widely used in industrial processes such as printing.

Blade

'Basically, you spread the material onto a substrate using a blade,' explains Adjokatse. The blade can be set to produce a film with a thickness of around 500 nanometres, creating the 2D perovskite layer. 'The important point is that these films are very smooth with large crystalline domains of up to 15 micrometres,' says Adjokatse. The smooth 2D films based on 2-phenylethylammonium lead iodide were used as a template to produce 3D formamidinium lead iodide films. This was achieved by dipping the 2D film in a solution containing formamidinium iodide. This resulted in the growth of a 3D film through 'cation exchange', where formamidinium took the place of 2 phenylethylammonium. 'These films show much higher photoluminescence compared to reference 3D formamidinium lead iodide films and show increased stability when exposed to light or moisture,' says Loi. 'This means that we now have a method for the production of high-quality films for perovskite solar cells using an industrially scalable technique.'

EurekAlert, 21 March 2019

<http://www.eurekalert.org>

Seven killed in China plant explosion; second deadly blast this month

2019-04-03

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A recent plant explosion in China's Jiangsu province killed seven people authorities said, the second deadly blast in the province this month as Beijing begins a nationwide industrial safety inspection campaign. The blast involved a container of scrap metal that exploded in the outdoor yard of a metal-moulding plant in a bonded area in the city of Kunshan, causing the plant to catch fire, the local government said on its official Weibo account. "The cause of the incident is being investigated," it said. Five people were also injured, one severely, in the blast. Plant owner Kunshan Waffer Technology Corp Ltd, a Taiwan-based maker of magnesium alloy injection moulding products and aluminium alloy die castings, said the incident would reduce the company's April revenue by about 40-50 percent. The firm said it could not tell when production would be resumed in the plant in Kunshan. The company was fined last May by the Kunshan environmental protection bureau for violating water pollution rules, according to state-owned newspaper the Beijing News. Kunshan, about 70 km (43 miles) west of Shanghai, is home to more than 1,000 technology companies and manufacturers, including many Taiwanese firms. Sunday's incident follows a deadly blast on 21 March at a chemical park in the city of Yancheng, also in Jiangsu province, that killed 78 people and focused attention on safety at small chemical firms. Beijing said it will launch a month-long, nationwide inspection campaign into hazardous chemicals, mines, transportation and fire safety, adding that authorities needed to absorb lessons from the Yancheng disaster. The country has a history of major work safety accidents which often trigger inspection campaigns aimed at rooting out violations and punishing officials for cutting corners or failing their supervisory duties. China has clamped down on scrap metal imports as part of an environmental campaign against "foreign garbage", tightening supply sources for metal producers, as it aims to cut solid waste imports by the end of 2020.

Reuters, 31 March 2019

<http://www.reuters.com>

Chemours Quantifies Toxic PFAS Substitute Sent to South Jersey Plant

2019-04-03

The chemical company Chemours shipped thousands of pounds of a toxic PFAS substitute to its Chambers Works site in South Jersey between

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2015 and 2018, and generated specific quantities of chemical waste at the plant over a longer period, according to a newly released document that raises fresh concerns over the possible contamination of local drinking water. In a report to the U.S. Environmental Protection Agency, the company quantified nine shipments of GenX, a replacement for the PFAS chemical PFOA, to the plant over the three-year period. It also provided exact quantities of GenX waste that were generated as part of waste streams containing other materials between 2009 and 2017. The inbound shipments ranged from 3,451 kilograms (7,608 pounds) in January 2016 to 2,043 kg (4,504 pounds) in June 2017 — quantities that dwarf the tiny amounts, measured in parts per trillion, that New Jersey regulators have set as safe health limits for some other PFAS chemicals in drinking water. Although GenX has not been studied as fully as better-known PFAS chemicals like PFOA and PFOS, some scientists and state officials believe it is just as risky to human health as the chemical it is designed to replace. PFOA and other PFAS chemicals are linked to some cancers, immune-system problems, high cholesterol, and other illnesses. They have been found in many public and private water systems around the country, including New Jersey. In North Carolina, GenX from a Chemours plant at Fayetteville was found in the Cape Fear River, prompting state environmental officials to order the company to halt discharges of all fluorinated compounds in 2017.

Impacts on environment and public health

Jeff Tittel, director of the New Jersey Sierra Club, said the quantities of GenX shown by the document are significant, and represent a threat to air and water around the plant. "You are talking about chemicals that in parts per billion or trillion are harmful, and here we have 10 thousand pounds or more," Tittel said. "We are talking about a very hazardous chemical that has impacts to the environment and to public health." He said the shipments represent another potential source of contamination to a site that has been badly polluted since it opened in the late 19th century. "Shipping in more toxins, it boggles my mind considering how toxic that site is already," he said. Chemours, which was spun off from DuPont in 2015, did not immediately respond to a request for comment. The document, dated May 18, 2018, was obtained from the state Department of Environmental Protection through an open-records request from the environmental group Delaware Riverkeeper Network. Recently, the DEP said Chemours is currently using GenX and other PFAS-replacement chemicals for manufacturing at the Chambers Works site, and is discharging the

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chemical into water and air. In an order that also accused four other companies of PFAS pollution, the DEP noted that GenX has been found in some residential water wells near the Salem County site. Tracy Carluccio of Delaware Riverkeeper Network, a long-time campaigner for tighter curbs on PFAS chemicals, said the new information about GenX at Chambers Works may prompt the DEP to increase financial penalties on Chemours. "DEP expressly says they'll be looking at and requiring funding to clean up the replacements as well, so Chemours is not off the hook at all," she said. The company was also targeted this week by New Jersey Attorney General Gurbir Grewal, who filed a natural resource damage suit against the company, accusing it of contaminating the Chambers Works environment. While the existence of GenX shipments to the plant was previously known, the document — though partially redacted — provides the first public evidence of shipment quantities, their timing, and the amount of GenX waste generated over years.

Provides glimpse of plant operations

It also contains a series of responses from Chemours to the EPA's questions about how and when the company has been using GenX at the plant, whether it was made there, and whether it generated waste. The company said the chemical, also known as HFPO-DA, had never been manufactured at Chambers Works but was brought to the site as a raw material. It is used in the manufacture of Krytox, an industrial lubricant. Asked by the EPA whether there was any GenX waste present at the site, Chemours produced a table showing seven types of waste generated each year between 2009 and 2017, and what quantity of GenX was in each batch. It said all waste was shipped off site for treatment including incineration. But some parts of the document were redacted, obscuring the company's responses to EPA questions including what pathways allowed the escape of GenX into the environment at the plant, and how the company treats for the chemical. Asked to provide details of any GenX spills at the site, the company denied there had been any. "We are not aware of any spills of HFPO-DA at the Chambers Works site," the company said in its response.

NJ Spotlight, 29 March 2019

<https://www.njspotlight.com>

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MIT And NASA Unveil a Brand New Kind of Airplane Wing That Could Change How We Fly

2019-04-03

A team from NASA and MIT has created a new type of airplane wing — and it could make air travel far more efficient. In a paper published in the journal *Smart Materials and Structures*, the researchers describe how they built an airplane wing from hundreds of identical, lightweight cube-like structures, all bolted together and then covered with a thin polymer material. The design allows the wing to change shape automatically, adjusting itself to whatever configuration is optimal for the current phase of flight — with one configuration for take-off, for example, and another for landing.

Bigger And Better

The wing the researchers created and tested for the new paper is about the same size as what you'd find on a single-seater plane, according to MIT News, but they'd already demonstrated their design's feasibility with a smaller wing several years ago. Not only does this new wing show that the concept scales up to a size that could carry a person, but it also demonstrates a new manufacturing process that cuts the time needed to produce each individual structure down from several minutes to just 17 seconds. "The research shows promise for reducing cost and increasing the performance for large, light weight, stiff structures," Aurora Flight Sciences structures researcher Daniel Campbell, who wasn't involved in the research, told MIT News. "Most promising near-term applications are structural applications for airships and space-based structures, such as antennas."

Science Alert, 2 April 2019

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

Rice researchers find using certain stir bars can create laboratory errors

2019-04-03

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The stirrers that mix cream into your coffee probably don't make much difference to the drink. But in a chemistry lab, it turns out using the wrong stirrer can skew the science. Rice University scientists have determined that stir bars made of PTFE, more commonly known as Teflon, can introduce errors into a standard lab reaction used to manipulate the properties of carbon or boron-nitride nanotubes. Stir bars are pellet-like rods of ferromagnetic metal covered in PTFE that sit in the bottom of a beaker and are turned by a rotating magnetic field. They allow a solution to be mixed in a closed flask without manual stirring. The Rice lab of Angel Martí published a paper in the American Chemical Society journal ACS Omega outlining what happens when PTFE stir bars are used to functionalise nanotubes through Billups-Birch reduction, a long-used reaction developed in part by Rice Professor Emeritus of Chemistry Edward Billups that frees electrons to bind with other atoms. Reduction is often used to make nanotubes more amenable to functionalisation, the process of customising them for applications by adding molecules like proteins. That can be as simple as dispersing nanotubes in a chemical bath laden with the molecules you want to add. Billups-Birch is one such method, a one-step process used to functionalise nanotubes with a variety of molecules, according to the researchers. Rice University chemists discovered that stir bars covered in PTFE, also known as Teflon, react with chemicals in an unexpected way during the modification of nanotubes through Billups-Birch reduction. When they used it to modify nanotubes of boron-nitride, the researchers were surprised to see their tubes turn grey, while the PTFE stir bars turned black. Standard thermogravimetric analysis, usually adequate to see evidence of functionalisation, didn't see anything wrong – but the researchers did. "Aside from that, we couldn't get consistent results," Martí said. "Sometimes we would get very high functionalisation – or apparent functionalisation – and sometimes we wouldn't. That was really strange." They found the lithium in the ammonia-based solvent used in the Billups-Birch reaction was reacting with the white PTFE from the bars, turning them black. "Because carbon nanotubes are black, it would be easy to believe that nanotubes were depositing on the bars throughout the reaction," Martí said. "But that's not what happens. We found that in Billups-Birch conditions, the PTFE reacts. "Teflon doesn't generally react with anything," he said. "That's why it's used in stir bars, and in cookware. That's why it's also easy to overlook what we saw happening in the lab." Martí said search of the literature turned up nothing about avoiding PTFE in Billups-Birch. "That was odd, too," he said. "Maybe everybody else knows – but just in case we decided to explore the problem. That's why we decided to write a paper." The researchers suspect the unexpected reaction with Teflon is creating

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radicals that reduce the efficiency of the reaction and that can attack the boron-nitride or carbon nanotubes. In the meantime, their quick solution to the problem is perhaps the simplest. "Now we use glass-coated stir bars," Martí said. "Glass is completely inert. That gives us reproducibility and good functionalisation." Rice graduate student Carlos de los Reyes is lead author of the paper. Co-authors are Rice graduate student Ashleigh Smith McWilliams, research assistant Kendahl Walz-Mitra, undergraduate students Katharyn Hernandez and Selin Ergülin, and Matteo Pasquali, the A.J. Hartsook Professor of Chemical and Biomolecular Engineering and a professor of materials science and nanoengineering and of chemistry. Martí is an associate professor of chemistry, of bioengineering and of materials science and nanoengineering. The National Science Foundation, the Air Force Office of Scientific Research and the Welch Foundation supported the research.

Rice University, 29 March 2019

<https://news.rice.edu>

Featherweight oxygen' discovery opens window on nuclear symmetry

2019-04-03

Researchers at Washington University in St. Louis have discovered and characterized a new form of oxygen dubbed "featherweight oxygen" -- the lightest-ever version of the familiar chemical element oxygen, with only three neutrons to its eight protons. Oxygen is one of the most abundant elements in the solar system, but oxygen-11 can be produced only in a laboratory. It decays immediately after its creation by emitting two protons, and it can be observed solely through detection of its decay products. Two-proton decay is the most recently discovered nuclear decay channel. "What is most interesting to the nuclear physics community, however, is that oxygen-11 is the nuclear mirror of lithium-11, a very well-studied heavy isotope of lithium," said Tyler Webb, a PhD candidate in physics in Arts & Sciences at Washington University, who works with Robert J. Charity, research professor of chemistry in Arts & Sciences, and Lee G. Sobotka, professor of chemistry and of physics. Webb is the first author of a new paper on the discovery in *Physical Review Letters*. In nuclear physics, nuclei are said to be mirrors when one has a certain number of neutrons and protons and the other has a reversed amount,

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such as the 3:8 ratio of neutrons to protons in oxygen-11 as compared to the 8:3 ratio in lithium-11. "When talking about mirror nuclei, we expect a sort of symmetry to hold," Webb said. "The properties of a nucleus and its mirror should be similar: Quantum states should be roughly close in energy relative to the nucleus's ground state and the wave functions of those states should be similar." This symmetry can be stretched or broken, however. Scientists can compare the actual structure of mirror nuclei against their expected structure to learn more about this important symmetry of atomic nuclei, the stuff that composes the visible matter of the universe. In this case, the researchers are most excited to compare lithium-11, which they know has two very loosely bound neutrons in a "halo" orbiting its core, to oxygen-11, which has two unbound protons. The Washington University researchers pieced together evidence of oxygen-11 in an experiment conducted at the National Superconducting Cyclotron Laboratory on the campus of Michigan State University. The Physical Review Letters paper outlines both the experiment and the supporting calculations conducted by theoretical nuclear physicists Witold "Witek" Nazarewicz and Simin Wang of Michigan State University. Researchers from University of Connecticut and Western Michigan University also participated in the collaboration.

Science Daily, 1 April 2019

<http://www.sciencedaily.com>

Novel role of water in production of renewable fuels

2019-04-03

University of Oklahoma engineers in collaboration with the University of Tulsa have discovered a novel approach for the water-assisted upgrading of the renewable chemical, furfural, doubling or tripling the rate of conversion. "Energy and water are interconnected in the production of renewable fuels. On the one hand, energy is needed to extract, purify and distribute water. On the other hand, water is useful in producing energy," said Daniel Resasco, professor in the School of Chemical, Biological and Materials Engineering, Gallogly College of Engineering. "It is known that water plays an important role as an environmentally-friendly solvent, replacing organic solvents. The novelty is that it can accelerate the rate

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of hydrogenation.” In the chemical production of energy in conventional refining, the presence of water in the reactors is undesirable. Normally, when water is present in a reacting system where a catalytic reaction is taking place, it typically absorbs where the reaction should occur, which inhibits the rate of conversion. “A group of chemical engineering graduate and undergraduate students participated in the discovery of water as a participant in the catalytic conversion of furfural without inhibiting the reaction and leading to a great rate enhancement in the process,” said Bin Wang, assistant professor in the School of Chemical, Biological and Materials Engineering, Gallogly College of Engineering. Furfural is a biomass-derived compound that is considered a valuable platform for production of fuels and chemicals. An important strategy is to hydrogenate the molecule so it can be used in the chemical industry later. The group has shown that when the molecule contains an oxygenated group, hydrogenation occurs from the liquid phase instead of the catalyst surface. In the absence of water, all steps in the reaction occur on the catalyst surface. In the presence of water as a solvent, the hydrogen can be ‘shuttled’ through the water molecule in a higher rate for the reaction. This latter path requires a lower energy barrier to take place and is faster. An article describing this unique mechanism has been published in Nature Catalysis.

Science Daily, 1 April 2019

<http://www.sciencedaily.com>

Methane promising route for storage of renewable energy from sun and wind

2019-04-03

Storing renewable electricity in molecules can solve two problems at once: first of all, environmentally harmful CO₂ can be used as a feedstock, and secondly it can enhance the capacity to store renewable electricity in chemical bonds for long periods of time. The latter is necessary because traditional batteries do not yet have the capacity to ensure enough flexibility, stability and security to store wind and solar energy on a large scale for extended time periods. Utrecht University researchers published a Perspective article on the status quo of “power to methane” earlier this month in Nature Catalysis. First author Charlotte Vogt says, “Aside from understanding fundamental physical and chemical concepts behind

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catalytic reactions, I'm especially interested to know if and how the research I am doing can impact society. That's why I wanted to start this societally relevant, but still fundamental research project."

Ten times cheaper

Another process that can be used to store electricity in molecules is the conversion of water to hydrogen via electrolysis. This process is cheaper than methanation, because it involves fewer reaction steps. The researchers have now calculated that despite this higher cost of the process, it can still be beneficial to make methane out of CO₂ because storage of methane is ten times cheaper than hydrogen. This way, we can store electricity for seasons in a potentially cheaper manner than by using only hydrogen. "The important part of this idea is that we do not send the methane to houses, where it gets re-emitted as CO₂, but rather to recycle this carbon again and again in a closed-loop process," says Vogt. "This process of using methane as a chemical battery has an overall efficiency of roughly 34%, so we need a lot of CO₂ to ensure that our 'battery' gets big enough." Another option is to make methane out of sustainably resourced biomass or municipal waste. In this case, the methane could be sent to houses through our natural gas network. However, without a carbon tax this synthetic natural gas (SNG) will be more expensive than fossil methane, so it is unlikely that this process will come to fruition in the near future. The researchers thus conclude that 'Power to Methane' is indeed a promising research direction for certain geographical sweet spots in the world where there are many CO₂ emissions (near large scale industry for example, called point sources), together with the production of renewable electricity. Examples of such CO₂ point sources are petrochemical and metallurgical industries, both present in the Netherlands. The researchers finally conclude that the future of non-fossil fuel dependent energy supply is mainly dependent on how fast we can make the conversion of water to hydrogen much cheaper, and in the long run directly convert water and CO₂ into hydrocarbons, which we can directly use in the energy transportation grid, methane being an example of it. The work involved a close collaboration between Prof. Gert Jan Kramer of the Copernicus Institute of Sustainable Development at Utrecht University, and Charlotte Vogt, Matteo Monai, and Prof. Bert Weckhuysen, who are chemists at the Inorganic Chemistry and Catalysis group of Utrecht University. Bert Weckhuysen: "We have a responsibility as scientific researchers to be aware of the socioeconomical impact of our science, and catalytic chemistry in particular. By collaborating in this way, we utilise our combined

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knowledge to help determine what research and technology directions society should put emphasis on.”

Phys.org, 1 April 2019

<http://phys.org>

Technique to make transparent polythene films as strong as aluminium

2019-04-03

Research led by Professor Ton Peijs of WMG at the University of Warwick and Professor Cees Bastiaansen at Queen Mary University of London, has devised a processing technique that can create transparent polythene film that can be stronger as aluminium but at a fraction of the weight, and which could be used in glazing, windscreens, visors and displays in ways that add strength and resilience while reducing weight. In a new research paper entitled “Glass-like transparent high strength polyethylene films by tuning drawing temperature.” Published online today—1st April 2019—in the journal *Polymer*, the authors show that after carefully selecting the type polythene and by tuning the temperature during the creation of oriented polythene films a balance can be created that produces a highly useful and lightweight transparent material with a significant strength and resilience approaching, and in some ways, exceeding that of metals. Previously anyone looking to replace heavy and often brittle glasses with a transparent plastic have looked at conventional transparent plastics like polycarbonate (PC) and poly(methylmethacrylate) (PMMA) both of which possess relatively unsatisfactory mechanical performance compared to an engineering material like aluminium. Current methods of creating high strength plastic films such as hot-drawing of high-density polyethylene (HDPE) can lead to materials that can compete or even out-perform traditional engineering materials like metals. “The microstructure of polymers before drawing very much resembles that of a bowl of cooked spaghetti or noodles, while after stretching or drawing the molecules become aligned in a way similar to that of uncooked spaghetti, meaning that they can carry more load” explains Yunyin Lin, a Ph.D. student in Professors Peijs and Bastiaansen’s team. However, drawn polythene materials normally have an opaque appearance due to defects and voids introduced by the drawing process, limiting applications where both mechanical properties and optical transparency are required. Some success has recently been achieved by using highly specific additives in hot-drawn HDPE materials that can

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then produce 90% transparency while giving high strength. However, the research team led by Professors Peijs and Bastiaansen have now developed a new post-manufacturing technique for HDPE that endows strength and resilience while preserving transparency without using additives. The researchers took HDPE polythene sheets and drew out these sheets at a range of temperatures below the melting temperature of HDPE. By tuning the drawing temperature, they could achieve a transparency of 90% in the visible range. However, the best balance between strength and transparency was achieved at drawing temperatures between 90 and 110 degrees centigrade. Professor Ton Peijs of WMG at the University of Warwick said: "We expect greater polymer chain mobility at these high drawing temperatures to be responsible for creating fewer defects in the drawn films, resulting in less light scattering by defects and therefore a higher clarity". The highly transparent films possess a maximum resilience or Young's Modulus of 27 GPa and a maximum tensile strength of 800 MPa along the drawing direction, both of which are more than 10 times higher than those of PC and PMMA plastics. For comparison, aluminium has a Young's Modulus of 69 GPa and aerospace grade aluminium alloy can have tensile strengths up to around 500 MPa. However, polythene has a density of less than 1000 kg/m³ while aluminium has a density of around 2700 kg/m³, meaning that on weight basis these high strength transparent polymer films can outperform such metals. Professor Ton Peijs in WMG at the University of Warwick concludes that: "Our results showed that a wide processing window ranging from 90 °C to 110 °C can be used to tailor the required balance between optical and mechanical performance. It is anticipated that these lightweight, low-cost, highly transparent, high strength and high stiffness HDPE films can be used in laminates and laminated composites, replacing or strengthening traditional inorganic or polymeric glass for applications in automotive glazing, buildings, windshields, visors, displays etc."

Phys.org, 1 April 2019

<http://phys.org>

New 'blue-green' solution for recycling world's batteries

2019-04-03

Rice University researchers literally have a solution to deal with the glut of used lithium-ion batteries left behind by the ever-increasing demand

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for electric vehicles, cellphones and other electronic devices. The Rice lab of materials scientist Pulickel Ajayan used an environmentally friendly deep eutectic solvent to extract valuable elements from the metal oxides commonly used as cathodes in lithium-ion batteries. The goal, researchers said, is to curtail the use of harsh processes to recycle batteries and keep them out of landfills. The solvent, made of commodity products choline chloride and ethylene glycol, extracted more than 90 percent of cobalt from powdered compounds, and a smaller but still significant amount from used batteries. "Rechargeable battery waste, particularly from lithium-ion batteries, will become an increasingly menacing environmental challenge in the future as the demand for these through their usage in electric vehicles and other gadgets increases dramatically," Ajayan said. "It's important to recover strategic metals like cobalt that are limited in supply and are critical for the performance of these energy-storage devices," he said. "Something to learn from our present situation with plastics is that it is the right time to have a comprehensive strategy for recycling the growing volume of battery waste." The results appear in *Nature Energy*. "This has been attempted before with acids," said Rice graduate student and lead author Kimmai Tran. "They're effective, but they're corrosive and not eco-friendly. As a whole, recycling lithium-ion batteries is typically expensive and a risk to workers." Other processes also have drawbacks, she said. Pyrometallurgy involves crushing and mixing at extreme temperatures, and the harmful fumes require scrubbing. Hydrometallurgy requires caustic chemicals, while other "green" solvents that extract metal ions often require additional agents or high-temperature processes to fully capture them. "The nice thing about this deep eutectic solvent is that it can dissolve a wide variety of metal oxides," Tran said. "It's literally made of a chicken feed additive and a common plastic precursor that, when mixed together at room temperature, form a clear, relatively nontoxic solution that has effective solvating properties." A deep eutectic solvent is a mixture of two or more compounds that freezes at temperatures much lower than each of its precursors. In that way, she said, one can literally obtain a liquid from a simple combination of solids. "The large depression of freezing and melting points is due to the hydrogen bonds formed between the different chemicals," Tran said. "By selecting the right precursors, inexpensive 'green' solvents with interesting properties can be fabricated." When Tran joined, the Rice group was already testing a eutectic solution as an electrolyte in next-generation high-temperature supercapacitors. "We tried to use it in metal oxide supercapacitors, and it was dissolving them," said Rice research scientist and co-corresponding author Babu Ganguli. "The colour of the solution would change." The eutectic was pulling ions from the supercapacitor's

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nickel. "Our team was discussing this and we soon realised we could use what was thought to be a disadvantage for electrolyte as an advantage for dissolving and recycling spent lithium batteries," Ganguli said. That became Tran's focus, as she tested deep eutectic solvents on metal oxides at different temperatures and time scales. During tests with lithium cobalt oxide powder, the clear solvent yielded a wide spectrum of blue-green colours that indicated the presence of cobalt dissolved within. At 180 degrees Celsius (356 degrees Fahrenheit), the solvent extracted nearly 90 percent of lithium ions, and up to 99 percent of cobalt ions from the powder when certain conditions were satisfied. The researchers built small prototype batteries and cycled them 300 times before exposing the electrodes to the same conditions. The solvent proved adept at dissolving the cobalt and lithium while separating the metal oxides from the other compounds present in the electrode. They found that cobalt could be recovered from the eutectic solution through precipitation or even electroplating to a steel mesh, as this latter method potentially allowed for the deep eutectic solvent itself to be reused. "We focused on cobalt," said Rice alumnus Marco Rodrigues, now a postdoctoral researcher at Argonne National Laboratory. "From a resource standpoint, it's the most critical part. The battery in your phone will surely have lots of it. Lithium is very valuable too, but cobalt in particular is not only environmentally scarce but also, from a social standpoint, hard to get." He noted the Department of Energy is mounting new efforts to advance battery recycling technologies and recently announced a centre for Li-ion battery recycling. The path forward will require continued efforts. "It's likely we won't be able to recycle and replace mining completely," Tran said. "These technologies are relatively new, and there is a lot of optimization that needs to be done, such as exploring other deep eutectic solvents, but we truly believe in the potential for greener ways to do dirty chemistry. Sustainability is in the heart of the work I do and what I want to do for the rest of my career."

EurekAlert, 1 April 2019

<http://www.eurekalert.org>

Cleaning up oil using magnets

2019-04-03

In future, it could be possible to remove oil spills on the surface of the ocean by using magnets. An interdisciplinary group of researchers at

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Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU) led by Prof. Dr. Marcus Halik has developed functionalised iron oxide particles that can attract any types of hydrocarbons. The magnetic particles and their shells can then be removed from the water relatively simply and in an environmentally-friendly manner and can even be reused after being cleaned. The researchers have now published their study in the renowned journal *Advanced Functional Materials*. In the study, they describe how functionalised iron oxide particles can be modified with a self-assembled monolayer so that they only adsorb hydrocarbons. This group of chemical substances includes light compounds such as alkanes and aromates but also crude oil, petrol and diesel. Such hydrocarbon molecules surround the very fine particles as if they are being sucked in and reach a volume that can grow to 14 times the size of the core of the particle. A video on the researchers' website shows how iron oxide powder is applied to liquid oil and the instant transformation into a substance that can be removed by a magnet. Iron oxide is a magnetic substance by nature. In addition to the multiple reusability of the source material, the large surface to volume ratio provided by nanoparticles and the favourable ratio to the quantity of the hydrocarbons to be adsorbed all contribute to the very high efficiency of the process. In addition, it allows water to be completely cleaned of oil and oil products. Conventional methods, on the other hand, create dispersions or mixtures of substances that enable the hydrocarbons to be more easily digested by bacteria, but remain in the seawater until this process is complete. In addition to manufacturing and characterising the particles, the research involved experiments using various hydrocarbons and different sources of water at different temperatures supplemented by molecular simulations that enabled the materials to be improved further. Three working groups from the Faculty of Engineering and the Faculty of Sciences at Friedrich-Alexander Universität Erlangen-Nürnberg (FAU) contributed to the research that involved scientists led by Prof. Dr. Marcus Halik (Department of Materials Science and Engineering, Organic Materials and Devices), Prof. Dr. Andreas Hirsch (Department of Chemistry and Pharmacy, Organic Chemistry II) and Prof. Dr. Dirk Zahn (Professorship for Theoretical Chemistry, Computer Chemistry Centre). The work was supported by the Cluster of Excellence EAM (Engineering of Advanced Materials) from the Excellence Initiative of the German Federal and State Government and by the Graduate School for Molecular Science (GSMS) at FAU. In future, the system could help to considerably reduce the impact of contamination by oil on the environment. The FAU researchers are currently working with partners in industry to scale up the manufacturing of the materials and to transfer the concept to real applications in clean-up operations.

EurekAlert, 1 April 2019

<http://www.eurekalert.org>

Toward novel computing and fraud detection technologies with on-demand polymers

2019-04-03

Drawing inspiration from nature, researchers are making polymers with ever-more precise compositions on demand. Using multistep synthesis tools pulled from biology, biochemistry and organic synthesis, a group is reporting that it is developing ultra-high precision synthetic polymers with precisely controlled chain lengths and monomer sequences. The resulting information-containing macromolecules can be deployed for data storage, anti-counterfeiting and traceability technologies. The researchers will present their results today at the American Chemical Society (ACS) Spring 2019 National Meeting & Exposition. "There are basically two types of polymers," says Jean-François Lutz, Ph.D. "One type is plastic, which is made by humans. The other type is called a biopolymer, and it is a much more defined molecule. In fact, humans are mostly constructed with polymers -- DNA and proteins." Conventional chemistry fabrication techniques can produce polymers of irregular lengths and sequences. But, Lutz notes, nature is more precise. There is a huge difference in structural quality between humanmade and biological polymers, he explains. "The purpose of our work is to fill in the gap -- to make synthetic polymers using biological inspiration." Generally, sequence-controlled polymers can be constructed either by chain-growth or step-growth polymerizations. Both approaches can achieve polymer chains of different lengths. However, when different monomers are combined into polymers, they will vary in chain-to-chain composition and sequence. Such polymers are not ideal for applications, such as coding, in which a precise, uniform structure is needed. Lutz and his group at the Institut Charles Sadron have been working on building synthetic molecules with the same precision and uniformity as biological macromolecules. "We got the initial inspiration from DNA, which is a polymer made with four monomers: adenine, thymine, guanine and cytosine," Lutz says. "Although DNA is a polymer that codes for the very information that makes us human -- an important achievement -- it is really not the best structure for many other things. We thought that maybe we could make a polymer that is just

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as information-rich, but enhance the structure so it could be used for a variety of applications." The group constructs its synthetic polymers with fully controlled primary structures using solid-phase iterative chemistry, a process that was originally developed to make peptides, or short bits of proteins. In the last few years, the team has been making precisely tailored polymers for data-storage applications. In these polymers, each monomer or subunit stands for a specific piece of information. So far, the researchers have created tiny data storage devices made of layered sequence-coded polymers. Recently, they also have studied the crystallization of coded synthetic polymers and observed that the molecular bits that they contain occupy much smaller volumes than do the nucleotides in DNA. "Abiotic sequence-coded polymers are now well beyond proof-of-concept," Lutz says. "We were the first group. Now it is a trend or field in polymer chemistry." Lutz believes that within the next 10 years, his group will bring anti-counterfeiting and traceability technologies using their precisely tailored polymers to market. Counterfeiting of medical devices is a significant problem. The World Health Organization estimates that more than eight percent of the medical devices in circulation are counterfeits. Lutz's group is building and inserting sequence-defined polymers in medical devices like ocular implants. The polymers can be extracted later and identified by tandem mass spectroscopy. "When you can store code in a molecule, you can imagine that with a single molecule you can write something, such as the name of a company, a batch number or production date," Lutz says. "You have a molecule that you can directly blend with various materials, such as plastics or ceramics. We could put the molecule in the screen of a smartphone, a medical device or an implant in the body. We could even put it in a pricey luxury bag."

Science Daily, 1 April 2019

<http://www.sciencedaily.com>

Mirrors control chemical selectivity

2019-04-03

A chemical reaction transforms the molecules that make up matter. To influence chemical reactions, chemists typically act on the molecules themselves, rather than the space in which the reaction takes places. However, researchers at the University of Strasbourg have shown that chemical reactions can indeed be influenced simply by conducting them

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between two appropriately spaced mirrors, kept only micrometres apart, a vessel physicist call an “optical cavity”. Inside these microscopic “optical cavities”, like everywhere else in the universe, electromagnetic fluctuations happen, even in the dark. These fluctuations can be thought of as waves confined between two walls. When the walls are spaced at a suitable distance, the waves are amplified, just as the movement of a swing is amplified when pushed at regular intervals corresponding to its swinging frequency. When a liquid is injected between the walls of the cavity, the electromagnetic fluctuations interact with the molecules inside, provided that the cavity resonates with one of the molecule’s vibrations. If the interaction is strong enough, the vibrations and optical resonance form hybrid states (half photonic, half vibrational). In that case, the molecules can be said to be under the influence of vibrational strong coupling (VSC). The teams of professors Thomas Ebbesen and Joseph Moran, specialised in nanoscience and chemical catalysis, respectively, began a collaboration in 2015 to try to understand if VSC could have an effect on chemical reactions. The following year, they published a first article showing that it is possible to slow down the deprotection of a trimethylsilyl protecting group by fluoride by a factor of five. These promising results led them to try to control the selectivity of chemical reactions by VSC. In other words, to study the possibility of promoting the formation of one product over another in a transformation that could give two different outcomes. For this purpose, they designed a substrate comprising two distinct silyl groups that can react with the fluoride ion to form two different products. By tuning the optical cavity to different vibrations of the molecule, they could not only change the relative yield of two products, but also show which vibrations are involved in the reaction mechanism. This pioneering discovery is a proof of concept that opens the way to control chemical reactions by simple physical means: by adjusting the distance between two mirrors in the dark. Moreover, it is a tool to understand fundamental chemical reactivity. But the collaboration between the two teams does not stop there. They are currently studying other types of reactions to try to understand the rules that govern chemistry under the influence of VSC.

Phys.org, 28 March 2019

<http://phys.org>

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New polymer mixture creates ultra-sensitive heat sensor

2019-04-03

Scientists at the Laboratory of Organic Electronics have developed an ultra-sensitive heat sensor that is flexible, transparent and printable. The results have potential for a wide range of applications – from wound healing and electronic skin to smart buildings. The ultra-sensitive heat sensor is based on the fact that certain materials are thermoelectric. The electrons in a thermoelectric material move from the cold side to the warm side when a temperature difference arises between the two sides, and a voltage difference arises. In this present project, however, the researchers have developed a thermoelectric material that uses ions as charge carriers instead of electrons, and the effect is a hundred times larger. A thermoelectric material that uses electrons can develop 100 $\mu\text{V}/\text{K}$ (microvolt per Kelvin), which is to be compared with 10 mV/K from the new material. The signal is thus 100 times stronger, and a small temperature difference gives a strong signal. The results from the research, carried out by scientists at the Laboratory of Organic Electronics at Linköping University, Chalmers University of Technology, Stuttgart Media University and the University of Kentucky, have been published in Nature Communications. Dan Zhao, research fellow at Linköping University and one of three principal authors of the article, has discovered the new material, an electrolyte that consists of a gel of several ionic polymers. Some of the components are polymers of p-type, in which positively charged ions carry the current. Such polymers are well-known from previous work. However, she has also found a highly conductive polymer gel of n-type, in which negatively charged ions carry the current. Very few such materials have been available until now. With the aid of previous results from work with electrolytes for printed electronics, the researchers have now developed the first printed thermoelectric module in the world to use ions as charge carriers. The module consists of linked n- and p-legs, where the number of leg connections determines how strong a signal is produced. The scientists have used screen printing to manufacture a highly sensitive heat sensor, based on the different and complementary polymers. The heat sensor has the ability that convert a tiny temperature difference to a strong signal: a module with 36 connected legs gives 0.333 V for a temperature difference of 1 K. "The material is transparent, soft and flexible and can be used in a highly sensitive product that can be printed and, in this way, used on large surfaces. Applications are found within wound healing, where a bandage that shows the progress of the healing

Scientists at the Laboratory of Organic Electronics have developed an ultra-sensitive heat sensor that is flexible, transparent and printable.

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process is used, and for electronic skin," says Dan Zhao. Another possible application is in temperature exchange in smart buildings.

Phys.org, 1 April 2019

<http://phys.org>

Tiny optical elements could one day replace traditional refractive lenses

2019-04-03

A Northwestern University research team has developed tiny optical elements from metal nanoparticles and a polymer that one day could replace traditional refractive lenses to realize portable imaging systems and optoelectronic devices. The flat and versatile lens, a type of metalens, has a thickness 100 times smaller than the width of a human hair. "This miniaturisation and integration with detectors offers promise for high-resolution imaging in devices from small wide-angle cameras to miniature endoscopes," said Teri W. Odom, who led the research. She is the Charles E. and Emma H. Morrison Professor of Chemistry in the Weinberg College of Arts and Sciences and chair of the department of chemistry. The properties of metalenses depend on the rationally designed arrangement of nanoscale units. Metalenses have emerged as an attractive option for flat lenses but are currently limited by their static, as-fabricated properties and their complex and expensive fabrication. For imaging operations such as zooming and focusing, however, most metalenses cannot adjust their focal spots without physical motion. One major reason, Odom said, is that the building blocks of these lenses are made of hard materials that cannot change shape once fabricated. It is difficult in any materials systems to adjust nanoscale-sized features on demand to obtain tunable focusing in metalenses. "In this study, we demonstrated a versatile imaging platform based on fully reconfigurable metalenses made from silver nanoparticles," said Odom, a member of Northwestern's International Institute for Nanotechnology. "During a single imaging session, our metalens device can evolve from a single-focus lens to a multi-focal lens that can form more than one image at any programmable 3D position." The paper, titled "Lattice-Resonance Metalenses for Fully Reconfigurable Imaging," was published recently by the journal ACS Nano. The Northwestern team built their lenses out of an array of cylindrical silver nanoparticles and a layer of polymer patterned into blocks on top of the metal array. By simply controlling the arrangement of the polymer patterns, the nanoparticle array could direct visible light to any targeted focal points without needing to change the nanoparticle structures. This scalable method enables

A research team has developed tiny optical elements from metal nanoparticles and a polymer that one day could replace traditional refractive lenses to realise portable imaging systems and optoelectronic devices.

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different lens structures to be made in one step of erasing and writing, with no noticeable degradation in nanoscale features after multiple erase-and-write cycles. The technique that can reshape any pre-formed polymer pattern into any desirable pattern using soft masks made from elastomers. The research was supported by the Vannevar Bush Faculty Fellowship from the Department of Defence (grant no. N00014-17-1-3023) and the Air Force Research Laboratory (agreement number FA8650-15-2-5518).

Science Daily, 28 March 2019

<http://www.sciencedaily.com>

Fluorine: Toxic and aggressive, but widely used

2019-04-03

In toothpaste, Teflon, LEDs and medications, it shows its sunny side -- but elemental fluorine is extremely aggressive and highly toxic. Attempts to determine the crystal structure of solid fluorine using X-rays ended with explosions 50 years ago. A research team has now clarified the actual structure of the fluorine using neutrons from the Heinz Maier Leibnitz Research Neutron Source (FRM II). Fluorine is the most reactive chemical element and highly toxic. It is nonetheless widely deployed. In the first attempt to determine the atomic distances of solid fluorine in 1968, a research team in the United States used X-rays. A difficult task, because fluorine only becomes solid at about minus 220 °C. And already cooling down the aggressive element resulted in explosions. Nobel laureate Linus Pauling was sceptical about the results of the team and in 1970 proposed an alternative structural model -- without delivering the experimental proof. For 50 years, no other chemist ventured to take on the delicate task. Using neutrons from the Heinz Maier-Leibnitz Research Neutron Source in Garching, scientists from the University of Marburg, the Technical University of Munich (TUM) and the Aalto University in Finland have now finally elucidated the structure.

Neutrons -- the ideal probes

Neutrons are particularly well suited for localising fluorine atoms with high precision. Since they can penetrate even thick-walled sample containers, neutrons provided the method of choice for Professor Florian Kraus and his team in Marburg. They were supported in their investigations on the powder diffractometer SPODI at the FRM II by the TUM scientist Dr. Markus Hölzel and his colleagues. For their investigations, the researchers implemented a special measuring setup to study fluorine at very low

Investigations with neutrons settle scientific dispute about the structure of solid fluorine

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temperatures. To this end, they deployed materials that are particularly resistant to fluorine and ensure safe handling.

Application in LEDs, toothpaste and pharmaceuticals

“Extremely precise measurements with neutrons are important to facilitate calculations for a wide variety of applications,” says Florian Kraus. “For other elements, high-precision crystal structures have been available for years. The crystal structure of oxygen, for example, has been investigated 35 times and carbon even 108 times.” But fluorine is also an essential part of everyday life. Among other things, fluorides are used as additives to toothpaste. They are used in LED bulbs to turn the cold LED light into a warm white. Fluorine compounds are also added to many pharmaceuticals to increase their effectiveness.

Neutron measurements confirm the suspicions of the Nobel Prize winner

Even though the results of the measurements from the 1960s were not precise, Florian Kraus was nonetheless quite surprised by the great difference: “Using neutron measurements, we were able to resolve the atomic distance 70 percent more accurately,” says the chemist. “And the crystal structure shows that Nobel laureate Linus Pauling was spot on with his doubts.”

Science Daily, 27 March 2019

<http://www.sciencedaily.com>

Engineers craft the basic building block for electrospun nanofibers

2019-04-03

Electrospinning uses electric fields to manipulate nanoscale and microscale fibres. The technique is well-developed but time-intensive and costly. A team from Michigan Technological University came up with a new way to create customisable nanofibers for growing cell cultures that cuts out time spent removing toxic solvents and chemicals. Their work is published in *Materialia*. Smitha Rao, assistant professor of biomedical engineering at Michigan Tech, led the research. She said the approach is innovative, “we’re coming at this completely sideways,” and the team focused on streamlining electrospun nanofiber production. Nanofibers are used as scaffolds, made up of strands and pockets, that can grow cells. “We want an assembled, highly aligned scaffold that has ideal structures and patterns on it that cells will like,” Rao said. “Take a cell, put it on porous

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materials versus elastic materials versus hard materials, and it turns out the cell does different things. Usually you use varied materials to get these diverse characteristics. Cells respond differently when you put them on different surfaces, so can we make scaffolds that provide these different conditions while keeping the materials same?" In a nutshell, yes. And making customizable scaffolds is surprisingly simple, especially when compared to the laborious casting and additive processes typically used to produce scaffolds suitable for electrospinning. Plus, Rao's team discovered a pleasant side effect. "We take the polymers, then we put them into solutions, and we came up with this magical formula that works—and then we had to go electrospin it," Rao explained, adding that the team noticed something odd during the process. "We saw that the cells aligned without us applying anything externally. Typically, to make them align you have to put them in an electric field, or put them in a chamber and agitate the scaffold to force them to align in a particular direction by applying external stresses," she said. "We're basically taking pieces of this scaffold, throwing it in a culture plate and dropping cells on it." When spun in an electric field—imagine a cotton candy machine—the self-aligning cells follow the strand-and-pocket pattern of the underlying nanofibers. Rao's team, including lead author and Ph.D. student Samerender Nagam Hanumantharao and masters studentCarolynn Que, found that varying electric field strengths result in different pocket sizes. At 18 kilovolts, the magic happens and the fibres align just so. At 19 kilovolts, small pockets form, ideal for cardiac myoblasts. At 20 kilovolts, honeycombs of pockets expand in the fibres. Bone cells prefer the pockets formed at 21 kilovolts; dermal cells aren't picky, but especially like the spacious rooms that grow at 22 kilovolts. Rao's team tested a variety of polymer mixes and found that some of the most common materials remain tried-and-true. Their magical two-polymer blend let them manipulate the nanofiber pocket size; a three-polymer blend made tweaking the mechanical properties possible. The polymers include polycaprolactone (PCL), biodegradable and easy to shape, and conductive polyaniline (PANI), which together made a two-polymer blend, which could be combined with polyvinylidene difluoride (PVDF). "Because polyaniline is conducting in nature, people can throw it into the fibre matrix to get conductive scaffolds for cells such as neurons," Rao said. "However, no one has used these materials to manipulate the process conditions." Being able to use the same materials to create different nanofiber characteristics means eliminating chemical and physical variables that can mess with experimental results. Rao hopes that as more researchers use her team's blends and process that it will speed up research to better understand neural mechanisms, speed up wound healing technology, test cell lines and boost rapid prototyping in

A team from Michigan Technological University came up with a new way to create customisable nanofibers for growing cell cultures that cuts out time spent removing toxic solvents and chemicals.

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biomedical engineering. "We're trying to simplify the process to answer a highly complex question: how do cells proliferate and grow?" Rao said. "This is our basic building block; this is the two-by-two Lego. And you can build whatever you want from there."

Phys.org, 27 March 2019

<http://phys.org>

Fish slime: An untapped source of potential new antibiotics

2019-04-03

As current antibiotics dwindle in effectiveness against multidrug-resistant pathogens, researchers are seeking potential replacements in some unlikely places. Now a team has identified bacteria with promising antibiotic activity against known pathogens—even dangerous organisms, such as the microbe that causes MRSA infections—in the protective mucus that coats young fish. The researchers will present their results today at the American Chemical Society (ACS) Spring 2019 National Meeting & Exposition. "For us, any microbe in the marine environment that could provide a new compound is worth exploring," says Sandra Loesgen, Ph.D., the group's principal investigator. According to Loesgen, who is at Oregon State University, while novel chemical reagents have been found in the human microbiome, the marine equivalent remains relatively unstudied. One potential goldmine of microbes is the mucus that coats the surfaces of fish. This viscous substance protects fish from bacteria, fungi, and viruses in their environment, trapping the microbes before they can cause infections. The slime is also rich in polysaccharides and peptides known to have antibacterial activity. "Fish mucus is really interesting because the environment the fish live in is complex," says Molly Austin, an undergraduate chemistry student in Loesgen's laboratory, who conducted some of the studies. "They are in contact with their environment all the time with many pathogenic viruses." According to Austin, it would be interesting to figure out if anything in the mucus, which protects the fish, could actually help protect humans. Collaborator Erin (Misty) Paig-Tran, Ph.D., who is at California State University, Fullerton, supplied the mucus, swabbed from juvenile deep-sea and surface-dwelling fish caught off the Southern California coast. The team examined young fish because they have a less-developed immune system and more mucus on the outside of their scales that could contain a greater concentration of active bacteria than adult fish. Loesgen, Austin and graduate student Paige Mandelare isolated and screened 47 different strains of bacteria from the slime. Five

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bacterial extracts strongly inhibited methicillin-resistant *S. aureus* (MRSA), and three inhibited *Candida albicans*, a fungus pathogenic to humans. A bacteria from mucus derived from a particular Pacific pink perch showed strong activity against MRSA and against a colon carcinoma cell line. Austin is now focusing her work on the *Pseudomonas aeruginosa*, a Gram-negative bacteria derived from that fish, to study the many potentially interesting phenazine natural products and antibiotics that this bacteria makes. While the team members are interested in new sources for antibiotics to help humans, they are also looking at other ways to apply this knowledge. For example, the study of fish mucus could also help reduce the use of antibiotics in fish farming by leading to better antibiotics specifically targeted to the microbes clinging to certain types of fish. But first, the researchers want to understand more fundamental questions. For example, "We don't even know what a healthy microbiome is," Loesgen says. She explains that it's unclear whether the bacteria they studied in the fish slime were typical of their microbiomes and are protecting their hosts, or if these bacteria just happened to hitch a ride on these individual fish. Learning more about healthy fish microbiomes and how environmental factors in the Pacific can affect them could help inform conservation efforts, the researchers say.

Phys.org, 31 March 2019

<http://phys.org>

Same properties, lower cost

2019-04-01

Japanese scientists have developed a technique to transform a copper-based substance into a material that mimics properties of precious and pricey metals, such as gold and silver. The new medium, made of copper nanoparticles (very small copper-based structures) has promising applications in the production of electronic devices that would otherwise depend on expensive gold and silver counterparts. It is also suitable in the fabrication of electronic components using printing technologies that are recognised as environmentally friendly production methods. The study was published on January 29 in *Scientific Reports*, an online open access journal managed by Nature. The development of the Internet of Things (IoT) has quickly increased the demand for thin and wearable electronic devices. For example, IoT depends on communication between devices, which requires antennas that have so far required expensive gold and silver-based metal composites. To date, existing techniques for the preparation of copper nanoparticles have not been ideal as they

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resulted in impurities attaching to the material. Since these impurities could only be removed via extremely high temperatures, copper nanoparticles that were created at room temperature were impure and thus could not solidify into usable parts. Until now, this has been one of the hurdles to creating a more cost-effective alternative to gold and silver parts in electronic devices. The joint study between researchers at Tohoku University and Mitsui Mining & Smelting Co., Ltd in Tokyo reports the successful synthesis of copper nanoparticles with the ability of solidifying at much lower temperatures while remaining pure. The team has altered the structure of the copper nanoparticles and rendered them more stable so that they do not degrade at low temperatures. "Copper has been an attractive alternative material in the preparation of electric circuits. The most important part of using copper is altering it so that it solidifies at low temperatures. So far, that has been difficult because copper readily interacts with the moisture in the air and degrades, which turns into unstable nanoparticles. With the methods used in this study that alter the structure of the carbon and thereby making it more stable, we have successfully overcome this instability issue," adds Kiyoshi Kanie, Ph.D., associate professor at the Institute of Multidisciplinary Research for Advanced Materials of Tohoku University. The researchers hope to expand the application of their copper-based nanoparticles beyond just electronics. They believe that this material will be useful in other sectors as well. "Our method effectively created copper nanoparticle-based materials that can be utilized in various types of on-demand flexible and wearable devices that can be fabricated easily via printing processes at a very low cost," Kanie adds.

EurekAlert, 1 April 2019

<http://www.eurekalert.org>

Japanese scientists have developed a technique to transform a copper-based substance into a material that mimics properties of precious and pricey metals, such as gold and silver.

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Parasitic worms cause cancer—and could help cure it

2019-04-04

Billions worldwide are infected with tropical worms. Unsurprisingly, most of these people live in poor countries, kept poor by the effects of worm-related malnourishment. What may surprise many is that worms also cause the majority of cases of some cancers in these countries. Published in *Frontiers in Medicine* as a special article collection on parasite-associated malignancy, new research aims to inform prevention and treatment—and perhaps even turn worms against cancer.

Worms cause cancer

Over a million worm species are classified as helminths. A single characteristic unites them: parasitism. “Helminths take many forms, but all of them harm their host in some way. In humans, they can live in the intestinal tract, urinary tract or bloodstream, causing a variety of illness from malnutrition to organ failure” explains co-editor of the research Dr. Monica Botelho of Portugal’s National Institute of Health. In 2015 a more bizarre case of infection put helminths into the headlines: a man with HIV-AIDS died after his tapeworm contracted cancer and spread around his body. This remains the only such case ever recorded. Meanwhile, scientists have known for decades that helminths can turn human cells into cancers. “Three species of helminth are classified as class 1 carcinogens by the WHO,” adds Botelho. “These are all designated trematodes—after the Latin name for the grisly feeding cavity with which they latch onto their host’s insides.”

Worm-related cancer is not just a fluke—it’s three

Trematodes are known informally as ‘flukes’. In this case however, they’re anything but. “In endemic regions—predominantly sub-saharan Africa and Southeast Asia—flukes are responsible for the majority of all bladder and liver cancer cases,” says Dr. Joachim Richter, Associate Professor at Charité Berlin and co-editor with Botelho. “Cancers arise in sites of fluke infection including the bladder wall and the bile ducts of the liver.” But how does a worm cause cancer? According to the research collection, their feeding—and breeding—habits might be to blame. “Flukes constantly wound and re-wound their host as they latch on with their feeding cavity, burrow through organs, and deposit eggs in the bladder wall. This leads

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to chronic inflammation as the body tries endlessly to heal, meaning lots of cell division and so lots of opportunities for cancer-causing mutations to accumulate over years of infection. "The flukes' toxic toilet habits then add insult to injury. "Worms and their eggs also excrete proteins that exacerbate this chronic inflammation, further promoting cell division as well as the blood vessel growth required to feed it," adds Richter.

Hyper tapeworms protect hosts from cancer

Fluke infections and early stage cancers are often asymptomatic, so despite availability of anthelmintic drugs patients often present too late for curative treatment. Fortunately, flukes have an Achilles' heel: they require freshwater snails as a first host before infecting humans. "Flukes have been successfully eliminated in Japan by economic development and the filling and drainage of snail habitats," says Richter. "Eradication efforts are underway in Thailand, which has the world's highest rates of liver fluke infection and bile duct cancer—but some high-risk countries like Ethiopia lack a coordinated monitoring or prevention program for fluke-related cancer and need more help." Beyond eradication efforts lies another twist in the bizarre world of worms and cancer: helminths as a cure for malignancy. "Many parasites, including some helminths like the liver fluke *Fasciola hepatica*, inhibit cancer growth in vitro. Another of these—the ominously named 'hyper tapeworm' - is associated with a significantly lower rate of cancer in human hosts," reports Botelho. "In fact, there is evidence that proteins produced by hyper tapeworms as well as *F. hepatica* not only kill cancer cells directly—but might also enhance their host's immune response to tumours." "Even cancer-promoting fluke proteins might be repurposed as treatments for other conditions: for example, those that promote new blood vessel growth could help resolve chronic non-healing wounds in diabetics, tobacco users, and the elderly."

Medical Xpress, 25 March 2019

<http://medicalxpress.com>

Early test of male birth control pill shows no safety problems

2019-04-04

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After taking an experimental male birth control pill for 28 days, 30 men reported no serious side effects and the drug showed signs of decreasing sperm production, according to results of a phase 1 safety test reported Sunday in a poster session at ENDO 2019, the Endocrine Society's annual meeting in New Orleans. The purpose of phase I trials is to gather initial data on a drug's safety, not to test whether it's effective. In fact, the duration of the trial was insufficient to prove the pill's effectiveness as a contraceptive. That would take 60 to 90 days of use, the researchers said. Instead, the hormone changes seen in the volunteers were "consistent with effective contraception," according to a news release. The effects of the drug seemed to fade after the men stopped taking it. Five men (17 percent) reported a mildly decreased sex drive. Two (7 percent) experienced mild erectile dysfunction although, according to a news release, "sexual activity was not decreased." Side effects included fatigue, acne or headache and were seen in four to six men each. The drug, known as 11-beta-MNTDC, mimics testosterone. The study tested a base dose of 200 milligrams once daily in 14 people. Sixteen men got twice that dose. Another 10 received a dummy pill. The team, led by Dr. Stephanie Page of the University of Washington School of Medicine in Seattle, is planning longer studies of the drug, also known as 11-beta-methyl-19-nortestosterone dodecylcarbonate. The same team is testing another potential male birth control pill, dimethandrolone undecanoate, or DMAU.

Reuters Health, 26 March 2019

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

Long-term hormone use after menopause tied to Alzheimer's risk

2019-04-04

Women who take hormone replacement therapy (HRT) to ease menopause symptoms like hot flashes and night sweats may be slightly more likely to develop Alzheimer's disease, a large Finnish study suggests. Many women have been reluctant to use hormones for menopause symptoms since 2002, when the Women's Health Initiative (WHI) study in the U.S. linked treatments containing man-made versions of the female hormones oestrogen and progestin to an increased risk of breast cancer, heart attacks and strokes. While some previous research has also linked HRT to an increased risk of dementia, results have been mixed and offered

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little clarity about whether this risk should help inform women's decisions about hormone use. The current study involved almost 85,000 women diagnosed with Alzheimer's disease in Finland between 1999 and 2013 and a control group of about 85,000 similar women without this diagnosis. Roughly 30 percent of women in both groups used hormones; most took "systemic" hormones in tablet or pill forms but some used vaginal treatments. Compared to women who didn't use systemic hormones, those who did were 9 percent to 17 percent more likely to develop Alzheimer's disease. The biggest risk was for older women who used HRT for more than a decade. "These findings should not be a cause for alarm," said senior study author Dr. Tomi Mikkola of Helsinki University by email. "For the short-term management of hot flashes, night sweats and disruptive sleep, the benefits of hormone therapy clearly outweigh the risk." Women typically go through menopause between ages 45 and 55. As the ovaries curb hormone production, women can experience symptoms ranging from irregular periods and vaginal dryness to mood swings and insomnia. Different types of hormone therapy are available, for example, tablets containing oestrogen only or a combination of oestrogen and progestogen, as well as transdermal treatments, such as patches, gels and creams. Alzheimer's disease is the most common cause of dementia among older adults. The progressive brain disorder slowly erodes memory and thinking skills and eventually leaves people unable to handle basic tasks in daily life. Nearly all of the women in the study who had Alzheimer's were diagnosed at age 60 or older, and 56 percent of them were over 80 at the time of their diagnosis, researchers report in *The BMJ*. Three in four women with Alzheimer's who were taking HRT had been on hormones for more than 10 years when they were diagnosed. In absolute terms, the researchers calculate, HRT is associated with 9 to 18 additional cases of Alzheimer's disease per year detected in every 10,000 women ages 70 to 80, especially in those who used hormone therapy for over 10 years. The type of oral HRT - oestrogen only or in combination with progestogen - didn't appear to impact the risk of Alzheimer's. Vaginal forms of hormone therapy didn't appear connected to Alzheimer's disease risk. The study wasn't a controlled experiment designed to prove whether or how HRT might directly increase risk for Alzheimer's. It also wasn't designed to determine whether certain doses or forms of hormone therapy might directly contribute to that risk. Evidence from this and other research isn't compelling enough to warn younger women to avoid HRT just because they're concerned about Alzheimer's disease, Dr. JoAnn Manson of Harvard Medical School and Brigham and Women's Hospital in Boston writes in an editorial. "The randomised trials to date support the cognitive safety of oestrogen therapy when taken in early menopause," Manson

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said by email. "For recently menopausal women seeking treatment for bothersome hot flashes or night sweats, these observational findings should not discourage use of hormone therapy or materially influence decision making."

Reuters Health, 21 March 2019

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

Bacteria may travel thousands of miles through the air globally

2019-04-04

Bacteria may travel thousands of miles through the air worldwide instead of hitching rides with people and animals, according to Rutgers and other scientists. Their "air bridge" hypothesis could shed light on how harmful bacteria share antibiotic resistance genes. "Our research suggests that there must be a planet-wide mechanism that ensures the exchange of bacteria between faraway places," said senior author Konstantin Severinov, a principal investigator at the Waksman Institute of Microbiology and professor of molecular biology and biochemistry in the School of Arts and Sciences at Rutgers University-New Brunswick. "Because the bacteria we study live in very hot water - about 160 degrees Fahrenheit - in remote places, it is not feasible to imagine that animals, birds or humans transport them," Severinov said. "They must be transported by air and this movement must be very extensive so bacteria in isolated places share common characteristics." Severinov and other researchers studied the "molecular memories" of bacteria from their encounters with viruses, with the memories stored in bacterial DNA, according to a study in the journal *Philosophical Transactions of the Royal Society B*. Bacteriophages - viruses of bacteria - are the most abundant and ubiquitous forms of life on the planet, the study notes. The viruses have a profound influence on microbial populations, community structure and evolution. The scientists collected heat-loving *Thermus thermophilus* bacteria in hot gravel on Mount Vesuvius and hot springs on Mount Etna in Italy; hot springs in the El Tatio region in northern Chile and southern Chile's Termas del Flaco region; and hot springs in the Uzon caldera in Kamchatka, Russia. In bacterial cells infected by viruses, molecular memories are stored in special regions of bacterial DNA called CRISPR arrays. Cells that survive infections pass the memories - small pieces of viral DNA - to their offspring.

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The order of these memories allows scientists to follow the history of bacterial interaction with viruses over time. Initially, the scientists thought that bacteria of the same species living in hot springs thousands of miles apart - and therefore isolated from each other - would have very different memories of their encounters with viruses. That's because the bacteria all should have independent histories of viral infections. The scientists also thought that bacteria should be evolving very rapidly and become different, much like the famous finches Charles Darwin observed on the Galapagos Islands. "What we found, however, is that there were plenty of shared memories - identical pieces of viral DNA stored in the same order in the DNA of bacteria from distant hot springs," Severinov said. "Our analysis may inform ecological and epidemiological studies of harmful bacteria that globally share antibiotic resistance genes and may also get dispersed by air instead of human travellers." The scientists want to test their air bridge hypothesis by sampling air at different altitudes and locations around the world and by identifying the bacteria there, he said. They would need access to planes, drones or research balloons.

EurekAlert, 25 March 2019

<http://www.eurekalert.org>

House dust could be causing us to pile on the pounds

2019-04-04

If you're looking to lose a little weight this year it looks like it could be time for a spring clean. Researchers at Duke University have found that house dust contains chemicals that could be causing us to pile on the pounds. Endocrine-disrupting chemicals, compounds that replicate hormones naturally found in the body, found in household dust may trigger the development of fat cells in the human body, they say. The effect could be triggering increased fat growth in children relative to that ordinarily expected for their age. The chemicals are originally found in common household products such as laundry detergents, household cleaners, paints and cosmetics, and attach themselves onto dust particles through daily or weekly use. Previous research on fat cells isolated in the lab has shown that exposure to certain endocrine-disrupting chemicals found in household dust can cause them to accumulate triglycerides - a type of fat found in the blood. When we eat, our bodies convert any calories we don't immediately need to use into triglycerides. The triglycerides are then

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stored in fat cells until hormones trigger their release for use as an energy source. Similarly, studies in animals have also shown that endocrine-disrupting chemicals can lead to increased rates of obesity. For this latest study, the team collect nearly 200 house dust samples from homes in North Carolina. They then extracted more than 100 different chemicals from the dust in the lab and tested each of them for their ability to promote fat cell development in petri dish model. They found that around 70 of the chemicals had a marked effect on the development of dust-induced. What's more, they discovered that several of the chemicals were present in large quantities in the dust found in the homes of children who were significantly overweight or obese. "This is some of the first research investigating links between exposure to chemical mixtures present in the indoor environment and metabolic health of children living in those homes," said lead researcher Dr Christopher Kassotis of Duke University's Nicholas School of the Environment. "We found that two-thirds of dust extracts were able to promote fat cell development and half promote precursor fat cell proliferation at 100 micrograms, or approximately 1,000 times lower levels than what children consume on a daily basis." The team now plan to further study these chemicals to establish exactly which of them are a contributing factor to obesity in children.

Science Focus, 30 March 2019

<http://www.sciencefocus.com>

From Canadian Coal Mines, Toxic Pollution That Knows No Borders

2019-04-04

Massive open-pit coal mines in British Columbia are leaching high concentrations of selenium into the Elk River watershed, damaging fish populations and contaminating drinking water. Now this pollution is flowing across the Canadian-U.S. border, threatening the quality of U.S. waters. Paul Samycia was in a boat floating on British Columbia's Elk River when he reeled in a strange-looking trout. One side of the fish looked like any other cutthroat trout — black speckles, orange belly, olive back. The other side of the fish had a hole in its face. Its gill cover, the flap on the side of its head, was partially missing. Samycia snapped a photo of the fish. For the last four years, Samycia, the owner of Elk River Guiding Company, a fly-fishing shop and outfitter based in Fernie, British Columbia,

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has been collecting photos of misshapen catches. Some have shortened gill plates. Others have snubbed noses, making them look like they swam into a rock. He and fellow guides have amassed nearly 40 photos. Samyca started noticing the deformities about 10 years ago, but the sightings are becoming increasingly common. Scientists have found substantial evidence that the cause is selenium, a trace element, leaching from coal mines in the Elk River watershed. A 2013 study found heightened selenium concentrations downstream of mines in the Elk Valley, and a 2014 report linked high selenium to a slew of damaging ecological consequences in the river, including malformations and reproductive failure in fish. Environmental groups now are raising concerns about harm to the ecosystem, ranging from the Elk River's tributaries to waters downstream that cross into the United States. They also point to risks for human health in communities nearest to the mines, where selenium is contaminating drinking water. Meanwhile, tensions on both sides of the border are escalating: U.S. members of a binational water regulator sounded alarm bells last year, charging that Canadian members were suppressing scientific evidence related to the selenium pollution and its risks to the ecosystem and human health. The situation in the Elk has been called "a monumental selenium spill in slow motion." "We have one of the biggest selenium contamination issues in the world taking place in the Elk River," says one biologist.

The destructive consequences of selenium pollution are well documented in North America. In the 1970s, agricultural runoff carried high selenium loads into a reservoir in California's San Joaquin Valley, causing deformities in fish, reptiles, and birds. In the early 2000s, a vast mountaintop removal mining operation in West Virginia wrecked ecosystems in the Mud River. The problem in the Elk Valley is one of the most current and pressing examples. "We have one of the biggest selenium contamination issues in the world taking place in the Elk River," says Erin Sexton, a biologist at the University of Montana who has been studying the region for nearly 20 years. It's also one of the few cases to extend beyond borders. Now, scientists, conservation groups, industry, and government organisations from both Canada and the U.S. are trying to find a solution to one of the most complex, far-reaching selenium leaks either country has ever seen. The Elk River begins its journey in the Canadian Rockies and flows southwest for 140 miles through meandering oxbows before reaching Lake Koocanusa and the Montana border. Miners have excavated coal from the Canadian side of the watershed since the 1800s. In the past 40 years, large-scale, open-pit mining has come to dominate the region

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— a technique that involves stripping away layers of rock to get at coal deposits deeper in the earth.

Teck Resources, a Canadian mining company and the world's second largest exporter of steelmaking coal, operates five open-pit coal mines within the watershed. These mines are some of the biggest in Canada. Together, they have the capacity to produce more than 21.7 million tons of metallurgical coal, an essential ingredient in producing steel from iron ore. To get at the coal, the company uses a technique called cross-valley fill, which in practice, looks a lot like mountaintop removal mining. Workers dig into hillsides, creating massive, terraced craters – holes so big they make 550-ton trucks look like toys. They separate the valuable coal from the unwanted rubble and dump the debris into waste piles throughout the valley. Scratching away at the surface day and night, the company has moved enough earth to flatten mountains, all while filling valleys with massive heaps of rock. The piles of rubble are the source of the selenium problem. The trace element is naturally occurring and often accompanies the same geological formations as coal. When exposed to water and air, the element seeps out of rock and soil. In small amounts, selenium is necessary for biological function. At higher concentrations, however, it can become harmful. That's the "paradox of selenium," says Dennis Lemly, a retired selenium ecotoxicology expert who used to work as a researcher for the U.S. Forest Service and Wake Forest University in North Carolina. "Just a few times more than is required for normal health can be toxic." In humans, chronic exposure to high selenium concentrations can cause nausea, fatigue, skin lesions, and neurological disorders. In other animals, the high levels of the element have been shown to cause liver damage, paralysis, and even death. In Sparwood, a community of 3,490 people less than two miles from one of Teck's mines, selenium in drinking water is reaching concerning levels. The town, located within the traditional territory of the Ktunaxa Nation, pulled one of its water wells offline last spring when selenium exceeded British Columbia's drinking water standard of 10 micrograms per litre (selenium has been measured as high as 13.5 micrograms per litre, District of Sparwood records show). Last spring, Teck issued a statement warning landowners and farmers that "some mine-related constituents may be elevated." Company testing found that selenium levels in four private wells exceeded provincial standards. Teck did not comment on the specific selenium concentrations in these wells. In an emailed statement, Chris Stannell, a company spokesperson, wrote that Teck has worked with governments, scientists,

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and First Nations to develop a management plan to address the selenium issue and is “dedicating significant resources to taking the steps necessary to achieve the objectives” laid out in that plan. In the meantime, Sparwood has two other wells to provide residents with clean drinking water, and Teck is now financing the construction of a new well to replace the tainted one, according to Sparwood Mayor David Wilks. The company has also been supplying bottled water to landowners whose private wells contain selenium levels exceeding British Columbia’s standard. British Columbia’s guideline for the protection of aquatic life is 2 micrograms per litre. The U.S. Environmental Protection Agency’s standard is 3.1 micrograms per litre in rivers and 1.5 in lakes. In the Elk Valley’s waters, selenium has been recorded at 50 to 70 micrograms per litre and in some cases, as high as 100 micrograms per litre. Selenium levels were at least seven times higher in the Elk’s waters below mines than above them. Those high selenium levels have had major repercussions on the watershed, Sexton, of the University of Montana, says. “The impacts are pretty extensive.” She and her colleagues conducted one of the first publicly available scientific studies showing that mining in the Elk Valley was detrimental to the river’s ecosystems. They collected ecological and water quality data in both the Elk and its neighbouring watershed, the Flathead, which is considered relatively pristine.

Sexton was baffled by the differences she saw. Selenium levels were at least seven times higher in the Elk’s rivers below mines than above them or in the Flathead, according to a 2013 report she published. The researchers also found reduced algae and invertebrate diversity in the Elk compared to the Flathead — a sign that selenium pollution was killing off sensitive species. Algae and invertebrates form the base of the food web in a river system. The selenium they accumulate in their tissues gets transferred up the food chain. In fish, the element tends to concentrate in females’ eggs, either killing juvenile fish or causing major birth defects. “Then all of a sudden the fish start disappearing, and in a couple of years, they’re all gone,” says Richard Hauer, a now-retired limnologist from the University of Montana who co-authored the study with Sexton. If you weren’t paying attention to the early warning signs, you might not notice a selenium problem until it’s too late, he says. In the Elk Valley, scientists have been paying attention to the warnings. A 2014 review by Lemly, the selenium ecotoxicology expert, details evidence of selenium poisoning in fish, including tell-tale signs such as twisted spines and cranial deformities. Environment Canada, the federal agency that oversees

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environmental enforcement, asked Lemly to conduct the review as part of its investigation into selenium pollution coming from Teck's mines. Lemly's conclusions were unequivocal: Selenium levels in fish eggs and in surface waters are beyond those known to cause reproductive failure, he writes. In one of the Elk's tributaries with the highest selenium concentrations, the Upper Fording River, he estimates that the element is killing nearly half of juvenile fish — more than 180,000 fish each year. The Upper Fording is also home to a genetically pure and distinct population of westslope cutthroat trout (*Oncorhynchus clarkii lewisi*), which is a species of special concern in Canada. Lemly calls the fish a sentinel species. "As they go, the aquatic system goes," he says. The Upper Fording River is now closed to angling due to uncertainties about the viability of the cutthroat population. Meanwhile, questions remain about health risks linked to eating fish from river. "It's not an area that's being that well researched," says Lars Sander-Green, an analyst with Wildsight, a local environmental group. Although not specific to the Elk watershed, a 2017 study conducted by the Canadian government found that subsistence fishermen and First Nations who eat fish caught downstream from sources of pollution have high selenium blood concentrations. Prolonged exposure to selenium in humans can cause selenosis, a condition linked to hair loss, skin lesions, neurological disorders, and intestinal problems. A few miles north of the Montana border, water from the Elk River spills into Lake Koocanusa and drifts across the U.S. border to Libby Dam. There too, selenium levels have increased. David Naftz, a hydrologist with the U.S. Geological Survey (USGS), is part of a team collecting samples of water, sediment, fish tissue, and eggs to better understand how selenium moves through the ecosystem. "The large amount of selenium coming into Lake Koocanusa is concerning," Naftz says. There's an influx of upwards of 14,000 kilograms per year — seven times more than Utah's Great Salt Lake where USGS scientists reported selenium in the eggs of eared grebes and black-crowned night herons approaching levels that cause reproductive failure. Regulating an environmental problem that affects international waters is extremely complicated, experts say. Regulating an environmental problem that affects international waters is extremely complicated, experts say. In Montana, selenium standards are used to set discharge limits on permits. British Columbia employs a similar scheme. But conservation groups say the system on the north side of the border is broken. "We don't have anything enforceable," Wildsight's Sander-Green says. Water quality guidelines in British Columbia are just that — guidelines, not laws.

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The government in 2013 ordered Teck to develop a water quality management plan to address the selenium issue. But according to company reports, Teck exceeded the selenium limits laid out in the plan six times in 2016 and another 20 times in 2017. A 2016 audit shows British Columbia's provincial government granted Teck permits despite getting input from experts that the proposed selenium levels on those permits failed to protect the environment. U.S. commissioners from the International Joint Commission, a binational regulatory body that oversees shared Canada-U.S. waters, have also been critical. In a letter last year, they accused Canadian commissioners of minimizing scientific evidence on the valley's selenium problem and its risk to aquatic and human life. Sexton says she finds the continuous lack of regulatory response to the selenium issue shocking. "As a scientist, you do this kind of work with the objective that the data you collect will inform environmental decision-making," she says. But mining in the Elk Valley has steadily moved forward, despite mounting evidence pointing to the source of the problem. "From the big picture, it doesn't appear that there is any regulatory response at all," she says. The Canadian government is currently working on amendments to federal mining regulations that would place compliance limits on selenium discharges. British Columbia and Montana are also working to set selenium standards for Lake Kootenai by 2020. Once established, the binational standard would be used to inform discharge limits on permits on both sides of the border. Until then, the Ktunaxa Nation Council, along with other First Nations' leaders, are urging governments on both sides of the border to adopt more conservative interim standards for selenium in the lake. Teck plans to build six new waste treatment plants by 2030, but currently it has only one, and it had to be shut down at least twice because of technical problems since it came online in 2014. The company is considering other water treatment options too, such as systems that use microbes to remove selenium from water-filled pits. Some question whether those tools are capable of stopping such a massive selenium leak. These technologies have never been used at such a large scale, says USGS's Naftz. Meanwhile, three companies have proposed new mines in the Elk River watershed. Currently in the early stages of environmental assessment, each new mine would add another 8 million tons of coal production to the valley. Sexton says the area needs a moratorium on mining until technologies have been proven capable of mitigating pollutants. By continuing to issue mining permits, regulators are only letting the problem get worse, she says. But others point out that stopping the mining isn't necessarily going to make things better. "A moratorium on mining without a solution is just a moratorium," Hauer says. The region needs a long-term solution to deal with such a massive, long-term

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problem. For now, the mines show no signs of slowing. Trucks continue hauling rock waste to ever-growing piles; trains loaded with coal head toward the coast destined for overseas markets; the people of Sparwood worry about the safety of their drinking water; and fishermen collect photos of deformed fish for their growing file.

Yale Environment 360, 1 April 2019

<https://e360.yale.edu>

How to Minimise Exposures to Hormone Disrupters

2019-04-04

Experts say adults and children alike can benefit from avoiding canned goods and certain plastics and substituting natural products for commercial cleaning products. "We tend to think hormone disrupters are a mom and baby issue," said Dr. Leonardo Trasande, the chief of the division of environmental paediatrics at N.Y.U. School of Medicine. "But it literally can be a life and death matter for folks who are not even trying to have a family." Dr. Trasande is one of the doctors I work with in the paediatric clinic at Bellevue Hospital, and the author of "Sicker, Fatter, Poorer: The Urgent Threat of Hormone-Disrupting Chemicals to Our Health and Future ... and What We Can Do About It." There is significant evidence that several types of chemicals can in different ways interfere with the hormones that our bodies use as messengers for everything from sexual maturity and fertility to how we handle appetite and fat storage. Evidence has accumulated that these substances can change the ways that children's bodies develop, starting very early. "We are also looking more and more at not just exposures in pregnancy, but exposures before conception, which is very interesting," Dr. Trasande said. "It may be early exposures are shaping how gametes develop." But what can we actually do to shield ourselves (and our gametes) and our children? The subtitle of Dr. Trasande's book suggests that there are ways to protect ourselves and our families from substances that he and other environmental medicine specialists believe we will come to see as more and more dangerous, even at comparatively low levels. The four categories of particularly concerning chemicals include pesticides, which can contaminate our produce; phthalates, which are used in cosmetics and personal care products and also in many kinds of food packaging; bisphenols, which are in the lining of aluminium cans; and flame retardants used in electronics, furniture and mattresses. "There

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are straightforward, simple steps to reduce exposures that don't have to break the budget," Dr. Trasande said. He suggested avoiding canned food consumption, along with foods that are highly packaged or processed, and in particular avoiding plastic bottles or containers marked on the bottom with 3, 6 or 7. Plastics marked with a 3, he said, are worrisome for phthalates, which inhibit male sex hormones and disrupt metabolism. A number 6 denotes styrene, which is a known carcinogen. And plastics marked with 7 contain bisphenol, which in the lab has been shown to be related to obesity. He pointed to a recent study in *JAMA Internal Medicine*. In a group of more than 44,000 French adults 45 and older, a 10 percent increase in what is called "ultraprocessed food" was associated with a 14 percent higher risk of death from all causes. (Ultraprocessed foods are industrial products with many additives.) These are very difficult links to draw, and it's also possible that people who tend to eat ultraprocessed foods are making many other lifestyle choices that affect their health. One possible link might be, "phthalates and other food contaminants in those processed foods may inhibit testosterone function, which is known to be a major risk factor for adult cardiovascular disease and stroke," Dr. Trasande said. But this kind of study can show only an association, it doesn't establish cause and effect, and Dr. Trasande pointed out that the conclusions have been disputed by other experts. Even so, environmental health experts worry about both the food and the packaging. "Eat less processed food," said Manish Arora, professor of environmental medicine and public health at Icahn School of Medicine at Mt. Sinai. It's good for your body, he said, and "it's also good for the environment, less processing, less carbon footprint, less chemicals into the environment, less chemicals back into us." "Buy fresh food not wrapped in plastic," Dr. Trasande said, since the contact of the food with the packaging is what you want to avoid. "How to help our children improve their health?" Dr. Arora asked. "There's nothing like physical activity, fruits and vegetables." But beyond protecting yourself and your own family as far as you can, Dr. Trasande said, "there's so much we can do with the broader public action and social action." Dr. Arora said, "It's almost as if the products are released and then there's a slow and cumbersome process to see if they're harmful." Decades can go by before that process is complete, he said, and during those decades, "an entire generation has been exposed during the formative years." This was the story with lead, and more recently, he said, it was almost the story for many plastics. Lead was present in so many places in children's environments, from paint to auto emissions, and was gradually understood to be more and more dangerous, even at levels of exposure which had been thought to be safe. Dr. Arora also pointed to the importance of keeping household cleaning products which can contain

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“really nasty chemicals” away from children, and choosing products that contain fewer chemicals (the Environmental Working Group guide to healthy cleaning products can help). In an email, he wrote, “personally, like many folks these days I use homemade products for regular cleaning in areas that are not too dirty, such as lemon, baking soda, white vinegar.” It’s important to try to influence product manufacturers to move in the right direction, Dr. Arora said, and to take the trouble to look for products made in ways that minimise the impact on the consumer and more broadly on the environment, for example, by using biodegradable dyes. He buys jackets made from 100 percent recycled material, he said, and has switched to second-hand clothes.

New York Times, 1 April 2019

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

Car exhaust exposure has lifelong mental health effects

2019-04-04

Exposure to atmospheric lead during childhood results in lifelong mental health deficits, a 30-year study has found. Researchers led by Aaron Reuben from Duke University in North Carolina, US, followed a cohort of 579 people born between 1 April 1972 and 31 March 1973, in the small New Zealand city of Dunedin. The location was chosen as the target for the investigation because during the 1970s it had one of the highest atmospheric lead levels in the world – caused entirely by motor vehicle exhausts. There were no other contributing sources, such as lead pipes or paint. Levels of lead in the blood were measured when the cohort turned 11, providing a baseline standard. Almost all of them had levels that were above what today is considered concerning enough to warrant clinical attention. Each of the participants was given a clinical interview at 18, 21, 26, 32 and 38 years of age. The interviews were designed to assess mental health wellbeing in line with what is known as the Big Five Personality Inventory, which measures neuroticism, extraversion, openness to experience, agreeableness, and conscientiousness. Other psychopathological assessments, of internalising, externalising, and thought disorder symptoms were also made. The results of the study, published in the journal JAMA Psychiatry, are believed to represent the largest and longest investigation into the adult effects of childhood blood lead levels (BLLs) ever conducted. Reuben and colleagues found

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that the entire exposed cohort showed personality and psychological outcomes that were cause for concern. "Across nearly three decades of follow-up, childhood BLLs were associated with higher levels of general psychopathology, driven primarily by greater rates of internalising and thought disorder symptoms," they write. "Second, childhood BLLs were associated with higher neuroticism, lower agreeableness, and lower conscientiousness." The cohort spanned a wide range of economic, social and cultural positions, meaning that many aspects that can influence outcomes – such as poverty or poor education – could be taken into account. Doing so did not affect the outcome. "Each of these findings remained significant after adjusting for members' social class backgrounds, their mothers' IQs, and their family histories of mental illness," the authors report.

Cosmos, 1 April 2019

<https://cosmosmagazine.com>

Generation-long epidemic': Compensation funds running out as 9/11-related illnesses rise

2019-04-04

Thomas Wilson rarely left Ground Zero in the dizzying month following the attacks of September 11, 2001. A New York City police sergeant at the time, Wilson spent his days sifting through the tangled, charred rubble of the World Trade Centre. When night came, he slept for a few hours in one of the makeshift dormitories that sprung up around the site — a fierce sense of duty prevented him from being anywhere else. "A job had to be done," he said. "It was the right thing to do." Wilson counted himself lucky for escaping that day when so many others didn't. But seven years later, 9/11 caught up with him. He was diagnosed with a rare tongue, and later, skin cancer—both of which doctors said were linked to his time spent at Ground Zero. Wilson, a father of five, was shocked but not entirely surprised. He remembered the lack of proper protective gear and the metallic odour of the toxic brew of carcinogens that hovered over what he, and other first responders, dubbed "The Pile." "It just perforated everything," he said. Wilson is one of more than 11,000 first responders and survivors who've been diagnosed with a 9/11-related cancer, according to the World Trade Centre Health program, part of the U.S. government's Centres for Disease Control and Prevention (CDC). In 2011,

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about 60,000 people were registered as having 9/11-related illnesses. By December 2018, that number was higher than 93,000, according to WTC Health Program. The growing number has put crippling pressure on the September 11 Victim Compensation fund, set up by the U.S. government to provide financial aid for the sick and the families of those who've died from their illnesses. The fund is running out of money faster than expected and, to ration what's left, future payments are set to be cut by up to 70 per cent — a decrease that could mean undue financial stress, in addition to life-changing health challenges, for people impacted by that awful day. "I am painfully aware of the inequity of this situation," the administrator of the fund, Rupa Bhattacharyya said in the fall. "But the stark reality of the data leaves me no choice." Before the cuts were announced, compensation rates for people diagnosed with 9/11-related ailments ranged from \$200,000 to \$340,000 US, depending on the type of illness and its severity. In order to be eligible for compensation, first responders must have been working at Ground Zero and then diagnosed with one of 65 cancers doctors in the WTC program have linked to the aftermath of 9/11.

'This is a generation-long epidemic'

Bhattacharyya's announcement prompted a group of 9/11 first responders and their families to travel to Capitol Hill earlier this month to pressure Congress for a fix. They appeared with Kirsten Gillibrand, a New York Senator and Democratic presidential candidate, as she announced a bipartisan bill that would make the fund — set to expire in 2020 — permanent. Doing so would likely render the compensation cuts unnecessary and protect those diagnosed with 9/11-related illnesses in the future. But the bill currently does not have enough votes to pass. "This is a no-brainer," said John Feal, a leading advocate for 9/11 first responders, whose foot was crushed by a steel beam as he removed debris from Ground Zero. "This is an ongoing thing; this is a generation-long epidemic." And it's only going to get worse, said doctors treating people with 9/11-related conditions. Some doctors estimate that more people will eventually die of 9/11-related conditions than the nearly 3,000 people who died on the day itself. Many of the cancers linked to breathing in toxic air potentially take decades to develop, meaning the scope of the crisis could grow exponentially in the coming years. "It's a huge problem," said Dr. Benjamin Luft, a physician at Stony Brook University Hospital who works with the WTC Health program. "Overall, the amount of suffering that occurs post-trauma far exceeds the amount of trauma that occurs at the time — even though that trauma itself was enormous."

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'We're coming down hat in hand'

The dire predictions make Feal's work all the more important to him. He's organised lobbying trips to Washington every time the fund has come under threat since it was first created in 2011. In 2015, a similar push to make it permanent was quashed by Republican lawmakers concerned over costs. Instead, Congress gave the fund \$7.3 billion US with the 2020 expiration date. Only about \$2 billion US remains, with thousands of claims waiting to be processed and more people registering every day. "We're coming down hat in hand," said Wilson. "We're begging for our brothers and sisters who are too sick to go and lobby on their own." And with each trip, the frustration grows. Wilson, who is still an active duty police officer, said it's insulting to meet lawmakers who pay lipservice to remembering the attacks but refuse to actually take care of those who were caught in the aftermath of that day. "If hypocrisy was a crime in Congress, I'd be locking people up," he said. It's a sentiment echoed by fellow first responder, Charles Sullivan, a former NYPD officer. In 2015, Sullivan was diagnosed with a rare form of lymphoma doctors said was related to working in Lower Manhattan following the attack. "Some people might say we're tired of hearing about 9/11, let it go," he said. "I'd love to let it go: if people weren't dying every day."

The gift that keeps on taking

It's a reality that Bridget Gormley and Robert Tilearcio Jr. know all too well. Their fathers were New York City firefighters who died prematurely after being diagnosed with 9/11-related cancers. Tilearcio's father travelled to Capitol Hill to lobby Congress in the years before he died of brain cancer in 2017 at age 58. Now Tilearcio Jr. goes in his place. "9/11 is the gift that keeps on taking," he said. "Hopefully those angels watching over us can maybe get into the heads of the people who don't want to vote yes." Both Tilearcio and Gormley work at law firm Barasch & McGarry, located just minutes from where the Twin Towers once stood. The firm specialises in advocating for those with 9/11-related illnesses. "I lost my father and I'm not going to get him back," Gormley said. "I've come to terms with that, but now I feel like I'm part of something bigger than me. It's cathartic almost." Partner Michael Barasch represented both of their fathers before they died. On 9/11, he watched from his office window as the South Tower collapsed. "I was like a deer in highlights," he said. "We are some of the same people that you've seen in those famous photographs covered in

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dust and ash, running up Broadway.” Like Feal, Barasch has made many trips to Washington on his clients’ behalf. “In many cases, it’s the difference between keeping your house and not keeping your house,” he said of the compensation cuts. “Congress just didn’t set aside enough money for all the people getting sick.” Gormley said one of the hardest parts of losing her father was thinking he survived 9/11 — that her family had dodged a terrible fate — only for that day to change his life so many years later. “You have survivors who are turning into victims,” she said. “Everyone’s looking over their shoulder wondering what’s going to happen next.”

Fear of the future

Rob Serra lives with that anxiety every day. He was 21 years old on 9/11, his first day on the job as a New York firefighter. His health problems began almost immediately as he suffered with an uncontrollable nosebleed while working at Ground Zero. Other issues followed. Nasal polyps had to be surgically removed, respiratory problems arose, and nerve damage means he sometimes relies on a wheelchair. His downward health spiral forced Serra to retire from the FDNY at just 33. “I feel like the sand is moving a little quicker through the hourglass,” he said. Serra now spends his time advocating for the fund. Compared to those waiting for their claims to be processed or the yet-to-be diagnosed, Serra said he’s lucky. He received his compensation before the cuts were announced — money to help take care of his young children now that he can no longer work. But it does little to ease his fear — a fear that stalks so many of 9/11’s first responders — that he won’t get to see his kids grow up. “I’m hoping to see them go to high school but I don’t know,” he said. “I can’t imagine that I got all these other illnesses so early on and I’m not going to get cancer.”

CBC.com, 31 March 2019

www.cbc.com.au

Some People Put on More Weight When They Become Active - Here’s Why

2019-04-04

Governments are always telling us to eat less and exercise more to be healthier, but this presents an obvious problem. Being active is liable

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to make you hungrier, so there's a risk you end up eating extra to compensate, and putting on more weight than if you'd never got off the sofa in the first place. Dieticians dream of the day when they can design diets for people where they are more active but don't get hungry in the process. Unfortunately, it's trickier than you might think: we're still searching for the mechanism that governs how the energy we expend translates into our level of appetite. And as we shall see, that's by no means the only thing that makes this area complicated. In an ideal world, the human body would be wired to immediately detect changes in the amount of energy we use and then give us the appetite to eat the right amount to balance it out. Alas not: we all get hungry two or three times a day, sometimes more, regardless of what we are getting up to. Our bodies also release far stronger signals about our appetite when we haven't eaten enough than when we've eaten too much. This poor daily feedback relationship helps to explain why obese people still experience strong feelings of hunger – that and all the cheap calorie-dense food that is widely available, of course.

Mysteries of appetite

There is much that we don't understand about the effect of increased activity. Most of us burn different amounts of calories on different days – gym-goers have days off, while everyone has days where they walk round more shops, do more housework or whatever. Studies don't find any clear relationship between these variations and the amount of food that the average person consumes on the day in question. But neither is it easy to say anything definitive. Most research has focused on people doing aerobic exercise, and has found, for instance, that while some highly trained and lean people tend to eat the right amount to compensate for the extra calories they burn, overweight people are more prone to over-eat. What could lie behind this difference? One possibility is that physiological processes change in people who do more exercise – for instance, their gut hormones might be released in different concentrations when they eat, potentially with a bearing on how much food they need. One longstanding question, dating back some 60 years, is where metabolism fits into the picture. Some important work published in 2013 by a team in Leeds found that overweight people were hungrier and consumed more calories than thinner people. Since overweight people have a higher resting metabolic rate – the rate at which the body burns energy while at rest – the group proposed that there was a correlation between this rate and the size of meals that people eat. The fact that people's resting metabolic rates are stable, regardless of fluctuations

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in daily exercise, might help explain why exercise levels often have no bearing on how much we eat on the same day. Yet this doesn't mean that resting metabolic rate actually determines how much food we eat. The team proposed that a person's body composition, specifically their amount of muscle mass, might be governing their metabolic rate. If so, the metabolic rate might just be acting as an intermediary – routing the information about body composition through hypothalamic networks in the brain, which are believed to control appetite. Either way, this still needs further research.

Our study

To examine what happens in the real-life situation, rather than the lab setting, I've co-authored a new study that looks at what happens to people's calorie intake on days when they are more active without deliberately taking exercise – this could be anything from a trip to the dentist to a day out at the beach with the children. We looked at 242 individuals – 114 men and 128 women. We found that their amount of activity did have a bearing on how much they ate, but that their resting metabolic rates influenced their appetites as well – in other words, overweight people tended to eat more. This is another step forward in understanding the relationship between activity and the calories we consume. But don't expect this to translate into a magic formula for optimising everyone's relationship with activity and food any time soon. There are many variables that have barely been taken into account by researchers. Most work has tended to focus on white men aged 20-30, for instance, yet there is evidence that women are more prone to compensate for extra physical activity by eating. Equally, different genetic characteristics are likely to be important – some people are more fidgety, for instance. Then there are differences in people's psychology and to what extent they use food as a reward. People who have been losing or gaining weight will have different appetite signals to people whose weight is stable. The time of the activity in the course of the day is likely to make a difference, too. I doubt that in my lifetime we will reach a point where we can look at any person's entire genetic make-up and tell them exactly what will work for them. What we can say from our study is that many people are liable to eat more when they are more active. Just moving more will not lead to spontaneously losing weight - people should be aware of this and watch how much extra they eat as a result.

Science Alert, 1 April 2019

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

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Acetaminophen's Surprising Psychoactive Effects

2019-04-04

Every day, millions of people turn to acetaminophen, also known as paracetamol – the active ingredient in Tylenol – to dull the occasional ache or pain. That's because few side effects accompany this highly effective over-the-counter drug when taken at recommended doses. A new side effect is starting to come to light, however. Research is now revealing that acetaminophen may subtly influence your emotions. To relieve pain, acetaminophen works its magic in the brain, but researchers still aren't entirely sure how this trick works – a remarkable fact considering the drug has been available without prescription for sixty years! It may impact an enzyme called cyclooxygenase, or it might modulate humans' endocannabinoid system. Some experts say one or both of these ideas tells the whole story, while others insist, we've barely scratched the surface. Regardless, whatever acetaminophen does in the brain also seems to alter how we perceive the world. One of the earliest and most elucidating studies on the topic was published back in 2010. A team of scientists from a variety of academic institutions in the U.S. found that subjects who took acetaminophen were not as sensitive to emotional pain compared to people given a placebo. "In two experiments, participants took acetaminophen or placebo daily for 3 weeks," they described. "Doses of acetaminophen reduced reports of social pain on a daily basis." The team also found a "smoking gun" of sorts when conducting brain scans on the participants. "We used functional magnetic resonance imaging to measure participants' brain activity, and found that acetaminophen reduced neural responses to social rejection in brain regions previously associated with distress caused by social pain and the affective component of physical pain." Five years later, a team from Ohio State recruited 167 subjects and exposed them to negative and positive images, asking the participants to evaluate the stimuli. Subjects given 1,000mg of acetaminophen described the imagery as less emotionally arousing and evaluated unpleasant stimuli less negatively and pleasant stimuli less positively, compared to subjects given a placebo. "These findings suggest that acetaminophen has a general blunting effect on individuals' evaluative and emotional processing," they wrote. Acetaminophen may also reduce one's empathy for pain. In a double-blind, placebo-controlled study with over 200 participants, researchers at Ohio State University found that subjects given 1,000mg of acetaminophen expressed less empathy compared to those given a placebo when "reading scenarios about another's physical or social pain, witnessing ostracism in the lab, or visualizing another study participant receiving painful noise blasts." How

Research is now revealing that acetaminophen may subtly influence your emotions.

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should we view these intriguing trials? Do the subtle, yet present effects of acetaminophen witnessed in the lab affect real-world decision making? Hard to say for sure, but the doses used in these studies are equivalent to just two extra strength Tylenols, so regular users of acetaminophen-based painkillers are undoubtedly being emotionally affected in some fashion. And if you think you can avoid having your emotions dulled by switching to ibuprofen, sorry, it probably has the same effects. Of course, we could just shrug our shoulders and say “who cares?” In modern society where all sorts of stimuli exert unnoticed, mind-altering influences, what’s the problem with a bit of emotional blunting? But wait, maybe that’s the just the Tylenol talking...

Real Clear Science, 30 March 2019

<https://realclearscience.com>

Dead People And Pets Are Being Forged Into Pretty Blue Diamonds - Here’s How It Works

2019-04-04

When a person dies, cremation is an increasingly popular option. The practice eclipsed burials in the US in 2015 and is expected to make up more than half of all body disposals by 2020, according to the Cremation Association of North America. But instead of storing a loved one’s remains in an urn or sprinkling them outside, a growing number of bereaved consumers are doing something more adventurous: forging the ashes into diamonds. This is possible because carbon is the second-most abundant atomic element in the human body, and diamonds are made of crystallised carbon. Researchers have also improved ways to grow diamonds in the lab in recent years. While at least five companies offer a “memorial diamond” service, Algordanza in Switzerland is one of the industry leaders — its services are available in 33 countries, and the company told Business Insider it sold nearly 1,000 corporeal gems in 2016. Algordanza also claims to be the only company of its kind that operates its own diamond-growing lab for cremains — one of two in the world. (The other is in Russia.) “It allows someone to keep their loved one with them forever,” Christina Martoia, a spokesperson for Algordanza US, told Business Insider. “We’re bringing joy out of something that is, for a lot of people, a lot of pain.” Here’s how the company uses extreme heat and pressure to turn dead people — and sometimes animals — into sparkling gems of all sizes, cuts, and colours. Making a diamond from a dead person begins with cremation. The process typically leaves behind about 2.2kgs to 4.5kgs of ashes, much of which is carbon. Martoia said Algordanza

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requires a minimum of 500g of cremains. 'That's kind of the magic number, where our engineers can guarantee there will be enough carbon to make a memorial diamond,' she said. When the company receives ashes from a customer, a technician puts a sample into a special oven to see if there's enough carbon to grow a diamond. If there's not enough, the amount of carbon in a lock of hair can make up the difference. Once there's enough carbon, the element is extracted and purified of contaminants like salts. 'We use an acidic chemical to get rid of impurities,' Martoia said. This bumps the carbon purity of the processed ashes to about 99% or greater. The other 1% contains impurities like boron -- an element and micro-nutrient that helps humans (and other animals) grow bone, heal wounds, and regulate the immune system. Boron is the impurity that colours the rare blue diamonds found in nature -- and is why many 'memorial diamonds' come out blue, too. 'The diamonds can range from clear to very deep blue,' Martoia said. 'The more boron, the deeper the blue.' When Algordanza processes ashes, Martoia says, 'it's nearly impossible to separate out the boron from the carbon'. This is because the two elements share similar weights and properties. To further purify the carbon to 99.9% or more, technicians pack it into a growing cell that contains iron and cobalt -- additives that help remove contaminants. The cell also contains a tiny diamond to help the carbon crystallise into a rough shape, since carbon crystallises best when it touches an existing diamond. The final purification step converts the carbon into slippery sheets of graphite -- the same type of carbon in pencils. Graphite's microscopic flat sheets of carbon are an ideal starter material for synthesising diamonds. Natural diamonds form out of carbon that gets stuck in lava tubes about a mile deep in the Earth's crust. To emulate that environment, Algordanza inserts the cell (now packed with graphite) into a platter and slides it into a high-temperature high-pressure (HPHT) growing machine. That machine can heat a growth cell to nearly 1,370 degrees celcius. It also squeezes the cell under 394,625kgs-per-square-inch of pressure. That's like the entire mass of the International Space Station bearing down on the face of a wristwatch -- then heating it up to a temperature exceeding that of lava. Depending on how big a customer wants their diamond to be, it can take six to eight weeks in an HPHT machine to coax graphite to crystallise into a gem. 'The larger the diamond, the longer it takes to grow,' Martoia said. When enough time has passed, technicians remove the puck of graphite and crack it open. Inside awaits a rough, uncut, and unpolished diamond. Some customers take the rough gem, but many opt to have their memorial diamonds cut, faceted, and polished by a jeweller in Switzerland. Algordanza's prices start at \$3,000 for a 0.3 carat diamond. Martoia said the average order is about 0.4 to 0.5 carat, though US customers usually

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request bigger, 0.8-carat diamonds. Orders for diamonds made from human cremains aren't the only type that Algordanza receives. 'First we had the cremains of a German Shepard and now we have cremains of a cat,' Martoia said.

Science Alert, 31 March 2019

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

Contact lenses that reduce eye itch may become a reality

2019-04-04

Experimental contact lenses that not only improve vision, but also ward off itchiness due to allergies, got a boost with the completion of two late-stage studies, according to a new report. The antihistamine-containing lenses, developed and tested by Johnson & Johnson, significantly quieted eye allergy symptoms, researchers reported in *Cornea*. "These are pretty encouraging results," said co-author Brian Pall, director of clinical science for Johnson & Johnson Vision Care. "Over 20 percent of people suffer from eye allergies. It has a pretty big impact on their quality of life." The two randomised trials - both funded by Johnson & Johnson - tested the effectiveness and safety of lenses that slowly release the antihistamine ketotifen. Together the trials included 244 volunteers whose ages ranged from 12 to 61. Participants either wore two antihistamine-treated lenses, two regular lenses without the antihistamine, or one of each - but they didn't know what they were wearing. After volunteers put the lenses in, they were exposed to allergens that would normally make their eyes itch. They were asked to rate on a scale of zero to four how itchy their eyes were at 15 minutes after the lenses were inserted and 12 hours after insertion. Scores were lower on average, by more than one point on a scale of zero to four, when volunteers had medicated lenses in. Between the two studies there were 24 adverse events, most of which were mild, the researchers reported. There were two more-severe adverse events that occurred in both eyes of one volunteer, which the researchers described as "excess tearing." Some of the volunteers who wore lenses with antihistamine reported no itching, while others reported itching that was bothersome, but tolerable, Pall said. Pall is very enthusiastic about the new lenses. "We are super excited to have this opportunity to publish on this technology," he said. Dr. Christopher Starr welcomed the new findings. "This is really novel and interesting on a number of levels," said Starr, an ophthalmologist and professor at New York-Presbyterian and Weill Cornell Medicine. "I do treat a lot of patients with seasonal allergies in New York

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City. Right now they're bracing for the first peak that comes from April to May." Currently Starr advises those patients to put antihistamine drops in their eyes 10 minutes before they put their lenses in. "Then they can wear them throughout the day," he said. "And then they put a second drop in their eyes after they take the lenses out." In fact, Starr said, "my own eyes itch and this is a product that on first glance - with this positive data - is something I would use myself." It's also reassuring that the new product is a combination of two items that have proven track records for safety, Starr said. Pall says he doesn't know when the new lenses might show up on store shelves. "Obviously we are committed to getting all the pieces in place for regulatory submission," he said. "In my experience it's very hard to predict how things will go when you start to meet and discuss with regulatory bodies. But we are encouraged by this robust clinical data that would support a submission (for approval) in the future."

Reuters Health, 30 March 2019

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

What's bad for the heart is also bad for the brain

2019-04-04

People who have risk factors for heart disease like diabetes, high blood pressure and obesity may also be more likely to develop structural changes in the brain that can lead to dementia, a recent study suggests. Researchers examined data on 9,772 adults, ages 44 to 79, who all had at least one MRI brain scan and provided general health information and medical records for the analysis. The researchers looked for associations between brain structure and so-called vascular risk factors. They found that except for high cholesterol, all of the other vascular risk factors - smoking, high blood pressure, high pulse pressure, diabetes, and obesity - were linked to abnormal brain changes seen in dementia. And the more vascular risk factors a person had, the poorer was their brain health, as evidenced by greater brain shrinkage, less grey matter (tissue mainly on the surface of the brain) and less healthy white matter (tissue in deeper parts of the brain). "There are some things that contribute to cognitive and brain aging that we cannot change (like our genes), so you could look at this like a list of things that we can have some agency over - so-called 'malleable' risk factors," said lead study author Simon Cox of the University of Edinburgh in the U.K. "There are so many other benefits to improving your cardiovascular health (improving diet, weight, exercise, blood sugar control) and stopping smoking, but in combination with other good evidence out there, maintaining brain health is probably another one,"

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Cox said by email. The strongest links between the vascular risk factors and brain structure were in 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. Risk factors for heart disease appeared to impact brain health just as much in middle age as they did later in life, researchers report in the *European Heart Journal*. And the risk of structural changes in the brain associated with cognitive decline also increased with each additional vascular risk factor, even in adults who appeared otherwise healthy, the study found. Smoking, high blood pressure and diabetes were the three vascular risk factors that showed the most consistent associations across all types of brain tissue. High cholesterol levels were not associated with any differences in the MRI scans. The study wasn't a controlled experiment designed to prove whether or how specific risk factors might directly cause dementia or cognitive decline. "The precise mechanisms underlying these findings are not entirely clear," said Dr. Jeffrey Burns, co-director of the University of Kansas Alzheimer's Disease Centre. "The findings do underscore our increasing recognition that dementia is a complex syndrome and that vascular factors contribute to brain changes that we see and expect in people who are diagnosed with Alzheimer's disease," Burns, who wasn't involved in the study, said by email. Still, there's enough evidence of the connection for patients to do what they can to promote brain health as they age, said Dr. Andrew Budson of the Veterans Affairs Boston Healthcare and Boston University School of Medicine. "Because smoking, hypertension, and diabetes were the strongest risk factors, if you have a number of risk factors, these are the most important ones to work on," Budson, who wasn't involved in the study, said by email. "Quit smoking cigarettes today," Budson advised. "Control high blood pressure and diabetes through medications, aerobic exercise, and weight loss. These measures can reduce the daily brain damage that will otherwise occur."

Reuters Health, 30 March 2019

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

Stowaway mozzies enter Australia from Asian holiday spots – and they're resistant to insecticides

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Planning a trip to the tropics? You might end up bringing home more than just a tan and a towel. Our latest research looked at mosquitoes that travel as secret stowaways on flights returning to Australia and New Zealand from popular holiday destinations. We found mosquito

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stowaways mostly enter Australia from Southeast Asia, and enter New Zealand from the Pacific Islands. Worse still, most of these stowaways are resistant to a wide range of insecticides, and could spread disease and be difficult to control in their new homes. Undetected insects and other small creatures are transported by accident when people travel, and can cause enormous damage when they invade new locations. Of all stowaway species, few have been as destructive as mosquitoes. Over the past 500 years, mosquitoes such as the yellow fever mosquito (*Aedes aegypti*) and Asian tiger mosquito (*Aedes albopictus*) have spread throughout the world's tropical and subtropical regions. Dengue spread by *Aedes aegypti* mosquitoes now affects tens to hundreds of millions of people every year. Mosquitoes first travelled onboard wooden sailing ships, and now move atop container ships and within aircraft.

Adults in your luggage

You probably won't see *Aedes* mosquitoes buzzing about the cabin on your next inbound flight from the tropics. They are usually transported with cargo, either as adults or occasionally as eggs (that can hatch once in contact with water). It only takes a few *Aedes* stowaways to start a new invasion. In Australia, they've been caught at international airports and seaports, and in recent years there has been a large increase in detections. *Aedes aegypti* mosquito detections per year at Australian international terminals – passenger airline terminals in white; seaports or freight terminals in black. In our new paper, we set out to determine where stowaway *Aedes aegypti* collected in Australia and New Zealand were coming from. This hasn't previously been possible. Usually, mosquitoes are only collected after they have "disembarked" from their boat or plane. Government authorities monitor these stowaways by setting traps around airports or seaports that can capture adult mosquitoes. Using this method alone, they're not able to tell which plane they came on. But our approach added another layer: we looked at the DNA of collected mosquitoes. We knew from our previous work that the DNA from any two mosquitoes from the same location (such as Vietnam, for example) would be more similar than the DNA from two mosquitoes from different locations (such as Vietnam and Brazil). So, we built a DNA reference databank of *Aedes aegypti* collected from around the world, and compared the DNA of the *Aedes aegypti* stowaways to this reference databank. We could then work out whether a stowaway mosquito came from a particular location. We identified the country of origin of most of the *Aedes aegypti* stowaways. The majority of these mosquitoes detected in Australia are likely to have come from flights originating in Bali. Now we can work with

We might not be able to use common insecticides to kill mosquitoes that arrive from other countries.

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these countries to build smarter systems for stopping the movement of stowaways. As the project continues, we will keep adding new collections of *Aedes aegypti* to our reference databank. This will make it easier to identify the origin of future stowaways.

New mosquitoes are a problem

As *Aedes aegypti* has existed in Australia since the 19th century, the value of this research may seem hard to grasp. Why worry about invasions by a species that's already here? There are two key reasons. Currently, *Aedes aegypti* is only found in northern Australia. It is not found in any of Australia's capital cities where the majority of Australians live. If *Aedes aegypti* established a population in a capital city, such as Brisbane, there would be more chance of the dengue virus being spread in Australia. The other key reason is because of insecticide resistance. In places where people use lots of insecticide to control *Aedes aegypti*, the mosquitoes develop resistance to these chemicals. This resistance generally comes from one or more DNA mutations, which are passed from parents to their offspring. Importantly, none of these mutations are currently found in Australian *Aedes aegypti*. The danger is that mosquitoes from overseas could introduce these resistance mutations into Australian *Aedes aegypti* populations. This would make it harder to control them with insecticides if there is a dengue outbreak in the future. In our study, we found that every *Aedes aegypti* stowaway that had come from overseas had at least one insecticide resistance mutation. Most mosquitoes had multiple mutations, which should make them resistant to multiple types of insecticides. Ironically, these include the same types of insecticides used on planes to stop the movement of stowaways.

Other species to watch

We can now start tracking other stowaway species using the same methods. The Asian tiger mosquito (*Aedes albopictus*) hasn't been found on mainland Australia, but has invaded the Torres Strait Islands and may reach the Cape York Peninsula soon. Worse still, it is even better than *Aedes aegypti* at stowing away, as *Aedes albopictus* eggs can handle a wider range of temperatures. A future invasion of *Aedes albopictus* could take place through an airport or seaport in any major Australian city. Although it is not as effective as *Aedes aegypti* at spreading dengue, this mosquito is aggressive and has a painful bite. This has given it the nickname "the barbecue stopper". Beyond mosquitoes, our DNA-based approach can also be applied to other pests. This should be particularly important for protecting Australia's A\$45 billion dollar agricultural export

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market as international movement of people and goods continues to increase.

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<http://www.theconversation.com>

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