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ENVIS ON HAZARDOUS WASTES

Newsletter

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Current News

Optical fiber monitoring key to waste oil recycling

Scientists are harnessing advanced fiber-sensor technologies to increase productivity and process safety in the waste oil recycling process

A Singapore research team is harnessing advanced fibre-sensor technologies to increase productivity and process safety in the waste oil recycling process.Worldwide, the disposal of used industrial and non-industrial lubricants generates over 40 million tons of waste oil annually. Less than 50% of this waste is systematically collected for proper disposal or recycling, with the remainder posing a serious threat to pollution of global air and water resources if inappropriately handled. Although recycled waste oil is sold mainly as ship fuel, burning it pollutes the environment because of its relatively high sulphur content.

Waste oil is recycled by means of a thermo-chemical process into water, carbon and diesel fuel. The process is conducted in an oxygen-free enclosure and involves temperatures higher than 300°C. Although no emissions are released into the atmosphere, the process is time consuming and requires considerable effort to monitor. Also, the acquisition of critical and accurate data such as temperature and pressure is a challenge, as the use of conventional electrical sensors within the process environment invariably poses a safety concern.

Scientists at Nanyang Technological University in Singapore are working closely with Trans Research Pte Ltd., the R&D arm of Trans Petroleum Pte Ltd. and SK Envirotech Pte Ltd., to develop advanced optical fibre sensors that can withstand the high temperatures essential to the thermo-chemical process without compromising data accuracy and integrity. They are also developing technologies that will reduce sulphur content in waste oil to reduce the environmental impact when the recycled product is used as ship or diesel fuel.

The team has two optical fibre sensors in the pipeline. One sensor incorporates an interferometer in a highly germanium-doped fibre and has shown high sensitivity to monitoring temperature. When

used in combination with a more conventional type of fibre, it can simultaneously measure temperature and strain. Another sensor being developed is made of photonic-crystal fibres used together with "SERS-sensing" applications, which can detect and discern various compounds in a mixture. Together, the team's sensors can be used for high-accuracy, real-time measurements of temperature, pressure, vibration, bending, rotation, strain and humidity in waste oil recycling systems. Although recycled waste oil is sold mainly as ship fuel, burning it pollutes the environment because of its relatively high sulphur content.

(Source:https://www.sciencedaily.com/releases/2016/05/160531131109.htm)

Intelligent sensors that map out presence of chemical pollutants in the sea

Newly developed sensors not only detect pollutants in very small quantities, but also work to establish the exact size and location of the polluted area, say researchers, adding that their use is expected to be very useful is large bodies such as oceans

Developed at the Polytechnic University of Valencia, the sensors not only detect pollutants in very small quantities, but also work to establish the exact size and location of the polluted area. Researchers at the Universitat Politècnica de València (Polytechnic University of Valencia, UPV) have designed an intelligent sensor system which enables the immediate detection and delimitation of toxic waste, diesel, and hydrocarbons in general in any body of water. So far tested under laboratory conditions only, it is able to detect even very small concentrations of chemical pollutants and maps out their precise location and spread. Sea pollution is a serious global issue that has adverse effects on not only the immediate natural environment (marine fauna and flora), but also on human health and the economy.

Jaime Lloret from the UPV's Research Institute for Integrated Management of Coastal Areas (ICIC) spells out the importance of a device like the one being developed: "Different chemical pollutants require different techniques for their clean-up. But the single most important factor for minimising the impact and damages to the affected area is how quickly they are detected. This is particularly critical in the case of oil spills, where a full clean-up is virtually impossible if decontamination efforts don't start immediately. The sensors developed by UPV researchers are embedded in small floating devices. Based on sophisticated algorithms, the system is made up of several such wireless nodes that move independently through the spill in search of its outer limits. The nodes use the real-time data collected via their hydrocarbon sensors and their relative positions to seek out the edges of the spill, the point where it meets non-contaminated water. By doing so the system is able to provide information as to the exact location and extent of the spill. This sensor system is the result of one of the main lines of research to emerge from the UPV's master's degree in the Assessment and Environmental Monitoring of Marine and Coastal Ecosytems, and was presented at 2015's IEEE International Conference on Communication.

(Source:https://www.sciencedaily.com/releases/2016/01/160111092610.htm)

Nanofur for oil spill cleanup

Some water ferns can absorb large volumes of oil within a short time, because their leaves are strongly water-repellent and, at the same time, highly oil-absorbing. Researchers have found that the oil-binding capacity of the water plant results from the hairy microstructure of its leaves. It is now used as a model to further develop the new Nanofur material for the environmentally friendly cleanup of oil spills.

Damaged pipelines, oil tanker disasters, and accidents on oil drilling and production platforms may result in pollutions of water with crude or mineral oil. Conventional methods to clean up the oil spill are associated with specific drawbacks. Oil combustion or the use of chemical substances to accelerate oil decomposition cause secondary environmental pollution. Many natural materials to take up the oil, such as sawdust or plant fibers, are hardly effective, because they also absorb large amounts of water. On their search for an environmentally friendly alternative to clean up oil spills, the researchers compared various species of aquatic ferns. According to the researchers, "we already knew that the leaves of these plants repel water, but for the first time now, we have studied their capacity to absorb oil." Aquatic ferns originally growing in tropical and subtropical regions can now also be found in parts of Europe. As they reproduce strongly, they are often considered weed. However, they have a considerable potential as low-cost, rapid, and environmental friendly oil absorbers, which is obvious from a short video at http://www.kit.edu/kit/english/pi_2016_115_nanofur-for-oil-spill-cleanup.php.

Eggbeater-shaped, wax-coated hairs make the leaves of the salvinia molesta aquatic fern highly water-repellent

The plants might be used in lakes to absorb accidental oil spills. After less than 30 seconds, the leaves reach maximum absorption and can be skimmed off together with the absorbed oil. The water plant named salvinia has trichomes on the leaf surface -- hairy extensions of 0.3 to 2.5 mm in length. Comparison of different salvinia species revealed that leaves with the longest hairs did not absorb the largest amounts of oil. Oil-absorbing capacity is determined by the shape of the hair ends. The largest quantity of oil was absorbed by leaves of the water fern *Salvinia molesta*, whose hair ends are shaped like an eggbeater. Based on this new knowledge on the relationship between surface structure of leaves and their oil-absorbing capacity, the researchers improved the 'Nanofur' material developed at their institute. This plastic nanofur mimics the water-repellent and oil-absorbing effect of salvinia to separate oil and water.

(Source: Claudia Zeiger, Isabelle C Rodrigues da Silva, Matthias Mail, Maryna N Kavalenka, Wilhelm Barthlott, Hendrik Hölscher. Microstructures of superhydrophobic plant leaves - inspiration for efficient oil spill cleanup materials. Bioinspiration & Biomimetics, 2016; 11 (5): 056003 DOI: 10.1088/1748-3190/11/5/056003 ; https://www.sciencedaily.com/releases/2016/08/160823083559.htm)

Coffee-infused foam removes lead from contaminated water

Coffee is one of the most popular drinks in the U.S., which makes for a perky population -- but it also creates a lot of used grounds. Scientists now report an innovative way to reduce this waste and help address another environmental problem. They have incorporated spent coffee grounds in a foam filter that can remove harmful lead and mercury from water.

Restaurants, the beverage industry and people in their homes produce millions of tons of used coffee grounds every year

worldwide, according to researcher Despina Fragouli. While much of the used grounds go to landfills, some of them are applied as fertilizer, used as a biodiesel source or mixed into animal feed. Scientists are also studying it as a possible material for water remediation. Experiments so far have shown that powder made from spent coffee grounds can rid water of heavy metal ions, which can cause health problems. But an additional step is needed to separate the powder from the purified water. Fragouli and colleagues wanted to simplify this process.The researchers fixed spent coffee powder in a bioelastomeric foam, which acted as a filter. In still water, the foam removed up to 99 percent of lead and mercury ions from water over 30 hours. In a more practical test in which lead-contaminated water flowed through the foam, it scrubbed the water of up to 67 percent of the lead ions. Because the coffee is immobilized, it is easy to handle and discard after use without any additional steps, the researchers say.

A foam filter made with used coffee grounds removes lead and mercury from contaminated water.

(Source: Asmita A. Chavan, Javier Pinto, Ioannis Liakos, Ilker S. Bayer, Simone Lauciello, Athanassia Athanassiou, Despina Fragouli. Spent Coffee Bioelastomeric Composite Foams for the Removal of Pb2 and Hg2 from Water. ACS Sustainable Chemistry & Engineering, 2016; DOI: 10.1021/acssuschemeng.6b01098; https://www.sciencedaily.com/releases/2016/09/160921095417.htm)

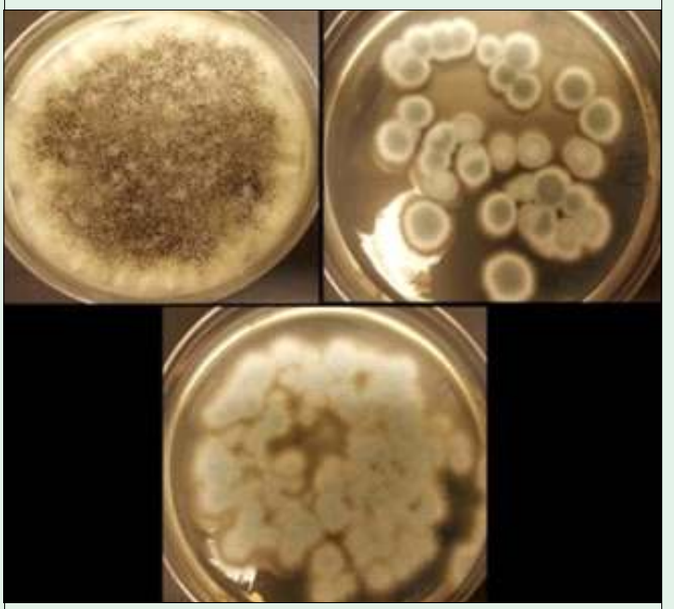
Fungi recycle rechargeable lithium-ion batteries

Rechargeable batteries in smartphones, cars and tablets don't last forever. Old batteries often wind up in landfills or incinerators, potentially harming the environment. And valuable materials remain locked inside. Now, a team of researchers is turning to fungi to drive an environment friendly recycling process to extract cobalt and lithium from tons of waste batteries.

The idea first came from a student who had experience extracting some metals from waste slag left over from smelting operations," says Jeffrey A. Cunningham, Ph.D., the project's team leader. "We were watching the huge growth in smartphones and all the other products with rechargeable batteries, so we shifted our focus. The demand for lithium is rising rapidly, and it is not sustainable to keep mining new lithium resources," he adds. Although a global problem, the U.S. leads the way as the largest generator of electronic waste. It is unclear how many electronic products are recycled. Most likely, many head to a landfill to slowly break down in the environment or go to an incinerator to be burned, generating potentially toxic air emissions. While other methods exist to separate lithium, cobalt and other metals, they require high temperatures and harsh chemicals. Cunningham's team is developing an environmentally safe way to do this with organisms found in nature -- fungi in this case -- and putting them in an environment where they can do their work. "Fungi are a very cheap source of labor," he points out. To drive the process, Cunningham and Valerie Harwood, Ph.D., both at the University of South Florida, are using three strains of fungi -- *Aspergillus niger*, *Penicillium simplicissimum* and *Penicillium chrysogenum*. "We selected these strains of fungi because they have been observed to be effective at extracting metals from other types of waste products," Cunningham says. "We reasoned that the extraction mechanisms should be similar, and, if they are, these fungi could probably work to extract lithium and cobalt from spent batteries."

The team first dismantles the batteries and pulverizes the cathodes. Then, they expose the remaining pulp to the fungus. "Fungi naturally generate organic acids, and the acids work to leach out the metals," Cunningham explains. "Through the interaction of the fungus, acid and pulverized cathode, we can extract the valuable cobalt and lithium. We are aiming to recover nearly all of the original material." Results so far show that using oxalic acid and citric acid, two of the organic acids generated by the fungi, up to 85 percent of the lithium and up to 48 percent of the cobalt from the cathodes of spent batteries were extracted. Gluconic acid, however, was not effective for extracting either metal.

The cobalt and lithium remain in a liquid acidic medium after fungal exposure, Cunningham notes. Now his focus is on how to get the two elements out of that liquid. “We have ideas about how to remove cobalt and lithium from the acid, but at this point, they remain ideas," he says. "However, figuring out the initial extraction with fungi was a big step forward." Other researchers are also using fungi to extract metals from electronic scrap, but Cunningham believes his team is the only one studying fungal bioleaching for spent rechargeable batteries. Cunningham, Harwood and graduate student Aldo Lobos are now exploring different fungal strains, the acids they produce and the acids' efficiencies at extracting metals in different environments.



The fungi *Aspergillus niger* (top left), *Penicillium simplicissimum* (top right) and *Penicillium chrysogenum* (bottom) can recycle cobalt and lithium from rechargeable batteries

(Source:https://www.sciencedaily.com/releases/2016/08/160821093037.htm)

How to clean-up toxic waste ... with onions & garlic

While toxic waste clean-ups have previously called for heavy duty chemicals, a team of Indian biotechnologists has developed a new form of cleanser - onions and garlic. While they're renowned for their ability to transform bland dishes into flavoursome meals, research has indicated that humble onion and garlic bulbs have the ability to filter harmful heavy metals from toxic brews.

A stroke of genius!

While on the search for new cleaning compounds, the Indian scientists decided to experiment with leftover onion and garlic compounds from nearby food canning factories. The blend was mixed with various industrial waste products and the results were surprisingly effective. According to the researchers, the two roots managed to absorb over 70% of toxins that were present in the various different waste products. These included notoriously toxic substances such as mercury, lead, tin, arsenic and cadmium.

Industry accredited research

The report was originally published in the *International Journal of Environment and Pollution* under the name*, "*Biosorption of heavy metals by utilising onion and garlic wastes. The researchers found that when conducted at 50°C, the speed of the clean-up process is largely influenced by pH levels. When pH was set to an optimum level, the use of onions and garlic was able to extract more than 70% of metallic pollutants. Once absorbed, the metals could then be released into a collection vessel and reused as biomass.

Authors Rahul Negi, Gouri Satpathy, Yogesh K. Tyagi and Rajinder K. Gupta explain, “Desorption indicates maximum 71% recovery of metal ions, making the remediation process cost effective and reusable. The biomasses were used for removal of heavy metals from both synthetic and industrial effluents and the technique appears industrially applicable and viable.”

A next generation approach to toxic waste removal

While the experiment was only tested on a small scale, the findings could have a pioneering impact on how toxic waste is dealt with in the future. Currently, the toxic waste removal process involves the use of ion exchange, chemical precipitation and electrochemical removal. As well as being only partially effective in the complete eradication of toxic chemicals, these methods chew up energy and produce a toxic sludge by-product.

An eco-friendly and cost effective alternative

As a natural resource, onions and garlic are environmental friendly materials that do not release harmful toxins into the air or have a negative impact on the ecosystem. The use of onions and garlic as toxic waste purifiers could also represent significant financial savings. For third world countries that do not have the resources or infrastructure to dispose of toxic sludge, the onions and garlic method could present a cost effective solution. For developed countries on the search for sustainable toxic waste removal methods, the use of the two roots is an innovative option. As the world continues to realise the importance of environmental friendly operations, the use of onions and garlic as toxic waste absorbers is definitely a method to keep an eye on! There are many new and emerging ways to tackle hazardous waste. One such route for the industrial industry is stabilisation, as opposed to alternatives like storage or expensive incineration methods.

(Source:https://www.pollutionsolutions-online.com/news/hazardous-waste/20/breaking_news/how_to_clean-up_toxic_waste_with_onions_garlic/31903)

Fluorescence method detects mercury contamination in fish

Researchers have developed a fluorescent polymer that lights up in contact with mercury that may be present in fish. High levels of the metal were detected in samples of swordfish and tuna. According to the conclusions of another study, mercury exposure is linked to reduced fetal and placental growth in pregnant women.

The presence of the toxic metal mercury in the environment comes from natural sources, however, in the last decades industrial waste has caused an increase in concentrations of the metal in some areas of the sea. In the food chain, mercury can be diluted either in organic form as methylmercury ($MeHg^{+}$) or as an inorganic salt, the cation Hg^{2+}. Now, researchers from the University of Burgos have created a fluorescent polymer, JG25, which can detect the presence of these two forms of mercury in fish samples. The development is published in the journal *Chemical Communications.* "The polymer remains in contact with samples extracted directly from the fish for around 20 minutes. Then, while is being irradiated with ultraviolet light, it emits a bluish light, which varies in intensity proportionally to the quantity of methylmercury and inorganic mercury present in the fish," explains Tomás Torroba, lead author of the paper. A portable polymer probe, which can be used *in situ*, was used to apply the technique to 2-gram samples from a range of fish species. The qualitative relationship between the mercury levels in fish and the increased fluorescence was verified using chemical analysis (called ICP-Mass).

The research showed that the larger is the fish the higher are the levels of mercury: between 1.0 and 2.0 parts per million for swordfish, tuna and dogfish, around 0.5 ppm in conger eels and 0.2 ppm in panga. No mercury was found in farmed salmon. These are large fish and at the top of the food chain, but the metal is not present in captivity due to the lack of an industrial or natural source. The toxicity of fish depends on the amount mercury found in the fish presented in the diet. According to the recommendations of the European Food Safety Authority (EFSA), the tolerable weekly intake of methylmercury should be no more than one serving containing amounts over 1.6 µg/kg (micrograms per kilogram of fish) or 4 µg/kg for inorganic mercury (this amount is close to the one detected in the study). However, the current trend for this limit is to be lowered. For example, the United States food safety agency, the FDA, goes beyond this and recommends consuming no more than one portion per week of fish containing concentrations over 1 µg/kg, a tendency

other countries are likely to follow. "Contamination of above 0.5 ppm in a food is already thought to be a considerable level," Torroba explains. "Several of the fresh tuna and swordfish samples we analysed exceed and even double this amount. This is why experts recommend that pregnant women reduce their weekly intake of certain types of fish, such as swordfish, due to possible risks to the fetus."

Mercury in pregnant women

In this context, a study led by researchers from the Foundation for the Promotion of Health and Biomedical Research of the Community of Valencia (FISABIO, for its Spanish abbreviation) and the Spanish Consortium for Research on Epidemiology and Public Health (CIBERESP, for its Spanish abbreviation) has shown that there is an association between prenatal mercury exposure and reduced placenta size and fetal growth. The study, carried out within the Environment and Childhood (INMA, for its Spanish initials) mother-child cohort project, aimed to evaluate this link using data on 1,869 newborns from different regions of Spain (Valencia, Sabadell, Asturias and Guipúzcoa). One of the largest studies carried out to date in order to determine mercury levels in umbilical cord blood samples and its association with different reproductive effects: measurements of fetal development (weight, height and head circumference at birth), placental weight, duration of pregnancy and risk of premature birth. The findings, published in the journal *Environmental Research*, show a relatively high average mercury concentration in umbilical cord blood (8.2 micrograms per litre), with a 24% of samples exceeding the WHO's provisional tolerable weekly intake equivalent.

"A double in the cord blood mercury concentrations (e.g. a change in the concentration from 8 to 16 micrograms per litre) is associated to a 7.7 gram reduction in the weight of the placenta and also shows a pattern of negative association with the newborn's head circumference," explain Mario Murcia and Ferran Ballester, co-authors of the study. "However no relation was found with other parameters, such as duration of pregnancy." The results of the INMA project suggest that prenatal mercury exposure may, therefore, be affecting the development of the placenta and fetal growth. Although the magnitude of these potential effects is small, reduced placental weight has been linked to the risk of high blood pressure in adulthood. Head circumference, in turn, has been associated with subsequent cognitive development. Despite preventive and surveillance measures are been considered for foods, due to the positive effects on health that are also linked to consuming fish, the researchers urge for public health efforts in order to reduce human mercury emissions.

(Source: Mario Murcia, Ferran Ballester, Ashley Michel Enning, Carmen Iñiguez, Damaskini Valvi, Mikel Basterrechea, Marisa Rebagliato, Jesús Vioque, Maite Maruri, Adonina Tardon, Isolina Riaño-Galán, Martine Vrijheid, Sabrina Llop. Prenatal mercury exposure and birth outcomes. Environmental Research, 2016; 151: 11 DOI: 10.1016/j.envres.2016.07.003; José García-Calvo, Saúl Vallejos, Félix C. García, Josefa Rojo, José M. García, Tomás Torroba. A smart material for the in situ detection of mercury in fish. Chem. Commun., 2016; 52 (80): 11915 DOI: 10.1039/C6CC05977E; https://www.sciencedaily.com/releases/2017/02/170220085135.htm)

Genetic tool to improve arsenic studies

Arsenic-contaminated drinking water impacts millions of people worldwide. Groundwater contamination is primarily caused by microbes that convert one form of arsenic into another form that can infiltrate groundwater. Researchers have now developed a genetic tool that makes it easier to identify which microbial species have arsenic-converting genes.

A team of Utah State University College of Engineering researchers developed a new primer -- a tool used in DNA amplification -- that simplifies the process of identifying bacteria found in soil and groundwater samples. Of interest are the bacteria species equipped with arsenate reductase genes. The genes enable bacteria to transform naturally occurring arsenic into a more toxic version of the element. The team's findings were published in *Applied and Environmental Microbiology* -- a leading journal, covering topics in biotechnology, microbial ecology, food microbiology and industrial microbiology. The authors explain that various bacteria transform, or reduce, arsenic V -- known as arsenate -- into arsenic III -- known as arsenite. Arsenite is more toxic to humans and is more mobile, meaning it moves through the environment more easily and can infiltrate groundwater. Researchers say a better understanding of the microbial ecosystems that release arsenite is an important first step in reducing the prevalence of arsenic contamination in groundwater. "Arsenic contamination is one of the biggest problems in drinking water all over the world," said Dr. Babur Mirza, a researcher at USU's Utah Water Research Lab and lead author on the study. "This new primer makes it easier for us to see which species of bacteria are present in a sample and whether they have the gene that we're looking for."

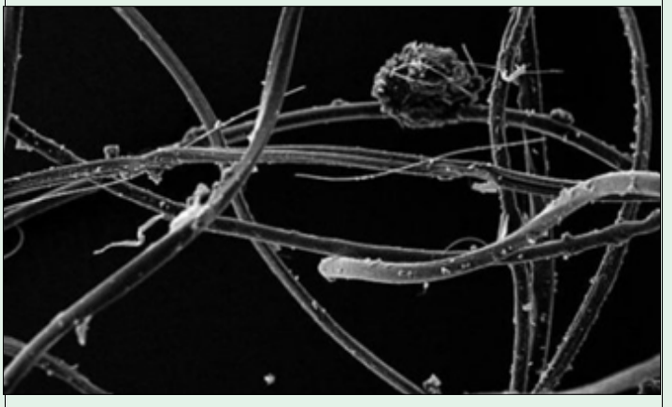
The new primer -- a short strand of DNA that targets the arsenate reductase gene -- helps researchers identify which bacteria in a sample have the genes. Without this primer, researchers had to first grow the bacterial cells in a laboratory before extracting their DNA and amplifying the gene. Such steps often reduced microbial diversity and led to biased results. "Now we can simply add the primer into the reaction and we get quantifiable copies of the reductase genes," said Mirza. "The copied genes show us which bacteria species are in the sample and tell us new information about the diversity of arsenate-reducing microorganisms." As part of the study, the team, led by co-author Dr. Joan McLean, pulled groundwater samples from 20 privately owned wells located in Northern Utah's Cache County. The results showed that 20 percent of the wells surveyed had arsenate and arsenite concentrations above the drinking water limit of 10 micrograms per liter. Researchers then tested whether the samples containing high arsenite concentrations also had an abundance of the arsenate reductase genetic material. Not surprisingly, they found a direct match. "We observed a significant correlation between reductase gene abundance and arsenite concentrations in the groundwater samples," said Mirza. "What this means is that wherever we find arsenite, we can expect to find microbes with arsenate reductase genes and vice versa." Mirza said the new primer successfully amplified the reductase genes and made it possible for his team to see a broad diversity of arsenate-reducing microorganisms. He said the new primers will be useful for studying bacteria in a range of environments. The authors say there are various implications to the study. McLean said a complete picture of the diversity of arsenate-reducing bacteria in a particular environment could lead to improved land use practices and awareness of human activities that may exacerbate the problem. "With this new information describing the diversity of arsenic-reducing microorganisms, we are further exploring relationships between these organisms and their biogeochemical environments that result in arsenic contamination of groundwater."

(Source: Babur S. Mirza, Darwin L. Sorensen, R. Ryan Dupont, Joan E. McLean. New Arsenate Reductase Gene (arrA) PCR Primers for Diversity Assessment and Quantification in Environmental Samples. Applied and Environmental Microbiology, 2017; 83 (4): e02725-16 DOI: 10.1128/AEM.02725-16; https://www.sciencedaily.com/releases/2017/02/170210150241.htm)

Washing clothes releases thousands of microplastic particles into environment

More than 700,000 microscopic fibres could be released into wastewater during each use of a domestic washing machine, with many of them likely to pass through sewage treatment and into the environment, according to new research.

A study by Plymouth University examined the mass, abundance and size of fibres present in waste effluent following washes of synthetic fabrics at standard temperatures of 30°C and 40°C. It found hundreds of thousands of tiny synthetic particles could be released in each wash, confirming earlier work at Plymouth University that the washing of clothes is a major source of microscopic fibres within the aquatic environment. The research, published in *Marine Pollution Bulletin*, was led by PhD student Imogen Napper in conjunction with Professor Richard Thompson, who is a leading international expert on microplastics and marine debris having worked in the field for more than 20 years. In the paper, the authors say: "The quantity of microplastic in the environment is expected to increase over the next few decades, and there are concerns about the potential for it to have harmful effects if ingested. But while the release of tiny fibres as a result of washing textiles has been widely suggested as a potential source, there has been little quantitative research on its relevant importance, or on the factors that might influence such discharges. That was the focus of our research." For the study, a series of polyester, acrylic and polyester-cotton items were washed at 30°C and 40°C using various combinations of detergent and fabric conditioner. Fibres were then extracted from the waste effluent and examined using an electron microscope to determine the typical size and any differences in mass and abundance among treatments. The research found that laundering an average washing load of 6kg could release an estimated 137,951 fibres from polyester-cotton blend fabric, 496,030 fibres from polyester and 728,789 from acrylic. The polyester-cotton blend was consistently found to shed fewer fibres than both the other fabric types, regardless of the differing treatments, however the addition of bio-detergents or conditioners tended to release more fibres.



A clump of acryllic fibres seen under microscopes at Plymouth University's Electron Microscopy Centre

Professor Thompson, who leads the International Marine Litter Research Unit at Plymouth University, recently gave both written and oral evidence to the microplastics inquiry held by the House of Commons Environmental Audit Committee, which led to recommendations for a ban on the use of microbeads in cosmetics. He said: "Clearly, what we are not advocating that this research should trigger something similar to the recently announced ban on microbeads. In that case, one of the considerations guiding policy intervention was the lack of clear societal benefit from incorporating microplastic particles into the cosmetics, coupled with concerns about environmental impacts. The societal benefits of textiles are without question and so any voluntary or policy intervention should be directed toward reducing emissions either via changes in textile design or filtration of effluent, or both."

(Source: Imogen E. Napper, Richard C. Thompson. Release of synthetic microplastic plastic fibres from domestic washing machines: Effects of fabric type and washing conditions. Marine Pollution Bulletin, 2016; DOI: 10.1016/j.marpolbul.2016.09.025; https://www.sciencedaily.com/releases/2016/10/161003103651.htm)

Coal ash selenium found in fish in North Carolina lakes

Contamination persists in fish years after exposure to power plant waste. High levels of selenium have been found in the tissues of fish in North Carolina lakes that receive coal ash effluents from power plants. Concentrations of selenium exceeding EPA-recommended thresholds for aquatic health were found in the liver, muscle, ovary and testes tissues of the fish, as well as in bottom waters at two of the lakes, despite the fact that selenium inputs have decreased or stopped in recent years.

A new Duke University study has found high levels of selenium in fish in three North Carolina lakes receiving power plants' coal ash waste. "Across the board, we're seeing elevated selenium levels in fish from lakes affected by coal combustion residual effluents," said Jessica Brandt, a doctoral student in environmental health at Duke's Nicholas School of the Environment, who led the study. Selenium is a naturally occurring element that is concentrated in coal ash and other coal combustion residuals. Early life exposure can cause deformities, impaired growth and reproduction, and in extreme cases death in fish and aquatic invertebrates. Because selenium accumulates in the food chain, it also can be toxic to birds that eat aquatic animals containing high levels. Brandt and her colleagues published their peer-reviewed study in the journal *Environmental Science & Technology*. They measured selenium levels in surface water, bottom-sediment waters and fish from three N.C. lakes -- Sutton Lake near Wilmington, Mayo Lake near Roxboro, and Mountain Island Lake near Charlotte. The three lakes are, or until recently were, discharge sites for effluents from coal-fired power plants. Four types of fish tissue were analyzed: liver, muscle, ovary and testes. The team also measured selenium in water, sediment and fish tissues in three similar lakes -- Adger, Tillery and Waccamaw -- with no such history of contamination. Samples were collected over a three-month period in spring 2015. "Catastrophic releases of coal ash like the Dan River spill of 2014 get all of the attention, but there is ongoing, continuous contamination of aquatic ecosystems from hundreds of coal ash ponds across the country," Brandt said. "People fish in these lakes for recreation and subsistence purposes. We want to protect these public resources." The EPA recently revised its selenium threshold criteria for aquatic health, and now places greater weight on concentrations in tissue rather than in water for evaluating ecosystem impacts. "Selenium concentrations in surface water don't tell us as much about the risk of exposure to fish," Brandt explained. Of the three coal ash discharge lakes tested in the new study, Sutton Lake had the highest levels of selenium. Eighty-five percent of all fish muscle samples examined there contained selenium levels above the EPA's threshold. In Mayo Lake, 27 percent of muscle samples exceeded the EPA criteria. Levels were below the EPA criteria in Mountain Island Lake. North Carolina has new coal ash management rules in place to close coal ash ponds at some power plants, Brandt noted. "But it will be important to continue monitoring sediments and fish tissues at these sites after the selenium inputs are stopped," she said. "You have to look beneath the surface to understand how these problems persist over time." The new study did not evaluate potential human health risks posed by the coal ash residual contamination.

(Source: Jessica E. Brandt, Emily S. Bernhardt, Gary S. Dwyer, Richard T. Di Giulio. Selenium Ecotoxicology in Freshwater Lakes Receiving Coal Combustion Residual Effluents: A North Carolina Example. Environmental Science & Technology, 2017; DOI: 10.1021/acs.est.6b05353; https://www.sciencedaily.com/releases/2017/02/170207162115.htm)

Sawdust reinvented into super sponge for oil spills

Oil spills could be cleaned up in the icy, rough waters of the Arctic with a chemically modified sawdust material that absorbs up to five times its weight in oil and stays afloat for at least four months.

Lowly sawdust, the sawmill waste that's sometimes tossed onto home garage floors to soak up oil spilled by amateur mechanics, could receive some new-found respect thanks to science. Researchers at the Department of Energy's Pacific Northwest National Laboratory have chemically modified sawdust to make it exceptionally oil-attracting and buoyant, characteristics that are ideal for cleaning oil spills in the icy, turbulent waters of the Arctic. The nontoxic material absorbs up to five times its weight in oil and stays afloat for at least four months. "Most of today's oil remediation materials are designed for warm water use," said PNNL microbiologist George Bonheyo, who leads the modified sawdust's development from PNNL's Marine Sciences Laboratory. "But as ice retreats in the Arctic Sea, fossil fuel developers are looking north, and we need new oil spill response methods that perform well in extreme conditions," added Bonheyo, who also holds a joint appointment in bioengineering with Washington State University.

“The chance of an oil spill in the Arctic is real," said fellow PNNL microbiologist Robert Jeters, who is also part of the project. "We hope materials like our modified sawdust can help if an accident happens.”

Fire and ice

Containing oil spills in cold waters is especially tricky, as bobbing ice chunks push oil below the water's surface, making it difficult to collect. The same goes for rough waters, whose tall, clashing waves disperse oil. The modified saw dust pulls double duty. Beyond absorbing oil, it also enhances another approach to combatting oil spills -- controlled burns. If changing weather or tides move spilled oil toward a sensitive area fast, oil can be burned before it can cause further harm. Called *in-situ* burning, the practice can significantly reduce the amount of oil in water and minimize its adverse environmental effects. Bonheyo and his team looked to develop an environmentally friendly and inexpensive material that floats despite rough or freezing waters and can support *in-situ* burning. Not wanting to create more pollution if emergency responders can't retrieve oil cleanup material, Bonheyo's team considered other natural ingredients like rice hulls and silica. But they ultimately found their winner in a fine dust called wood flour. A woodworking byproduct, wood flour is often used to make wood composites.

To make the dust into a thirsty oil mop, researchers chemically attach components of vegetable oil onto the material's surface. These attachments make the modified material oil-grabbing and water-shunning. The final product is a light, fluffy, bleached powder. The team is also trying out adding tiny, oil-eating microbes -- fungi and bacteria -- to the powder's surface so any left-behind material could naturally break down oil over time.

PNNL microbiologist Robert Jeters sprinkles PNNL's chemically modified sawdust onto a small oil spill inside the Arctic simulation lab, where researchers mimic extreme freezing conditions and make icy slush that is similar to what is found on the surface of the Arctic Sea

Just a sprinkle

Applying the modified sawdust is simple: sprinkle a thin layer over oil on the water's surface. The material immediately starts soaking up oil, creating a concentrated and solid slick that stays afloat thanks to the material's buoyant nature. The oil-soaked material can either be burned or retrieved. The team is using PNNL's unique Arctic simulation lab in Sequim, Washington to evaluate the material in icy waters. The facility is a customized shipping container that cools down to as low as 5 degrees Fahrenheit, which prompts researchers to don snowmobile suits and ski masks while they work. Ice slush forms on the surface of water that circulates inside a 290-gallon raceway pond placed inside the bitterly cold lab space. Oil is spilled on the slushy surface, followed by a sprinkle of modified sawdust. Tests have shown the material's water-repellent nature prevents ice from forming on it, allowing it to soak up oil and remain at the surface.

Researchers are also testing how well the material performs in controlled burns. They conducted initial burns this fall at the U.S. Coast Guard and Naval Research Laboratory's Joint Maritime Test Facility near Mobile, Alabama. Burn tests continue today at PNNL's Marine Science Laboratory. Early results indicate a small amount of material enables burning of both thin and thick layers of spilled oil. In the coming months, PNNL will further evaluate the modified sawdust. The material will need additional testing and approval by multiple agencies before it can be used at actual oil spills.

Sponge bacterium found to encapsulate arsenic drawn from environment

A new study sheds light on a unique biological model of arsenic detoxification. According to the new research, the Entotheonella bacterium that inhabits the Theonella swinhoei sponge is one of the only known cases of a bacterium protecting its host from metal poisoning.

Arsenic is the leading freshwater contaminant on the planet, affecting millions of people worldwide and causing an untold number of deaths every year. Removing arsenic from groundwater and freshwater is a major challenge still facing scientists and policymakers. Now a new Tel Aviv University study published in *Nature Communications* sheds light on a unique biological model of arsenic detoxification. According to the new research, the *Entotheonella* bacterium that inhabits the *Theonella swinhoei* sponge is one of the only known cases of a bacterium protecting its host from metal poisoning. *Entotheonella* safeguards these sponges against the dangers of arsenic and another common toxin, barium. "This particular sponge species, which is among the most ancient animals inhabiting the earth today, is home to a very diverse, very crowded number of microorganisms," said Prof. Micha Ilan of the Department of Zoology at TAU's Faculty of Life Sciences, who led the study. "These sedentary animals evolved to contain an in-house arsenal of chemicals and associated microbiota to deal with predators and pathologies."

A curious finding

While studying the biology of the sponge, which dwells in the Red Sea and the Indo-Pacific Ocean, Prof. Ilan and his colleague Dr. Boaz Mayzel discovered the curious ability of these sponges to accumulate and concentrate a million times more arsenic than that found in seawater. The results of that study were published in PLOS One in 2014. Dr. Ray Keren, also of TAU's Department of Zoology and co-author of the new research with Dr. Mayzel, suspected a bacterium was involved in the detoxification. Indeed, after extensive testing, a single bacterial species was found to drive the accumulation of both arsenic and barium. "We have not only discovered that a single bacterial species was the accumulator of both arsenic and barium. We have also found that this bacterium mineralizes the toxic elements, transforming them into inert products within its cells in a controlled manner," said Dr. Keren. "Sponges are eaten by turtles and worms, and even though they are exploding with arsenic, the bacteria renders them non-toxic. They

become biologically inert. It is a very unique biological model." TAU scientists, in collaboration with Prof. Boaz Pokroy of the Technion Institute of Science and Dr. Sirine Fakra of the Advanced Light Source in the Lawrence Berkeley National Lab, harnessed cutting-edge technology to validate their initial findings, which were procured using the backscatter mode of a scanning electron microscope. "Prof. Pokroy took a sample of *Entotheonella* to the European Synchrotron Radiation Facility within a week of seeing that first image," said Dr. Keren. "There, he saw that barium is mineralized as barite and arsenic formed smaller peaks of an unknown mineral."

"More work to be done"

Subsequent diffraction analysis revealed that the mineral, crystalline arsenic, was in fact calcium arsenate. Dr. Fakra then validated the presence of these minerals under subfreezing cryogenic conditions. "To render this unique detox method applicable to other situations, we need to somehow get rid of the sponge," said Prof. Ilan. "In other words, there is a lot more work to be done before we, human beings, can capitalize on this." The researchers are currently researching the mechanism the bacterium uses to control the mineralization of the elements. "Once we identify the enzymes involved in the process, we can either look for them in bacteria in polluted water or find a way to grow *Entotheonella* in polluted areas," said Dr. Keren.

(Source:https://www.sciencedaily.com/releases/2017/02/170227125217.htm)

Policies

Order of the National Green Tribunal in the matter of M/s. Swan Tanning Industries Vs. Central Pollution Control Board & Others dated 11/01/2017 regarding pollution caused by M/s. Swan Tanning Industries, Kanpur, Uttar Pradesh.

The joint inspection report dated 11th January, 2017 filed before NGT states that the unit does not have authorization for dealing with the hazardous waste, under the relevant rule. It was also found that the effluent discharged by the unit violated the prescribed parameters of Chromium.

(Source:http://www.indiaenvironmentportal.org.in/content/438914/order-of-the-national-green-tribunal-regarding-pollution-caused-by-ms-swan-tanning-industries-kanpur-uttar-pradesh-11012017/)

Notification on Regulation of Polychlorinated Biphenyls (PCBs) Order, 2016

This Order may be called, the Regulation of Polychlorinated Biphenyls Order, 2016. It shall come into force on the date of its final publication in the Official Gazette. The manufacture and import of the Polychlorinated Biphenyls in India shall be banned from the date of final publication of this Order. The import of Polychlorinated Biphenyls containing equipment shall be banned from the date of final publication of this Order. The import, export or trade of Polychlorinated Biphenyls contaminated equipment shall be regulated as per the provisions of the Hazardous Wastes (Management, Handling and Transboundary Movement) Rules, 2008. The use of Polychlorinated Biphenyls in any form shall be completely prohibited by 31st December, 2025.

(Source:http://www.indiaenvironmentportal.org.in/content/427632/notification-on-regulation-of-polychlorinated-biphenylspcbs-order-2016/)

Standard operating procedure and checklist of minimal requisite facilities for utilization of hazardous waste under Rule 9 of the Hazardous and Other Wastes (Management and Transboundary movement) Rules, 2016

There are provisions under Hazardous Waste Management Rules for utilization of various types of hazardous wastes. The Rule 11 of Hazardous Waste (Management, Handling and Transboundary Movement) Rules, 2008, stipulated that: The utilisation of hazardous wastes as a supplementary resource or for energy recovery, or after processing shall be carried out by the units only after obtaining approval from the Central Pollution Control Board. In order to enforce the aforesaid provision, CPCB has evolved Standard Operating Procedure (SoP) for processing the proposals of utilizing hazardous wastes other than co-processing in cement kilns. CPCB has received about 67 different proposals for utilization of 48 types of hazardous wastes, of which CPCB has so far developed 18 Standard Operating Procedures (SoPs) and check-list of requisite facilities for utilization of 14 types of hazardous wastes. Conditional permissions have been given to the units for utilization of hazardous wastes for which successful trial runs were conducted by CPCB. However, the procedure for utilisation of hazardous waste and other wastes has been modified in the recent notification - Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016.

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