VATIS UPDATE

Waste Management

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Apprise yourself with the latest technological innovations

Highlights

- Indonesia to generate energy from waste
- Recyclable plastic stronger than ABS
- Precious metals from e-waste
- Microbots to remove lead from wastewater
- Enzymes to clean up the environment
- Clean technology to limit styrene emissions

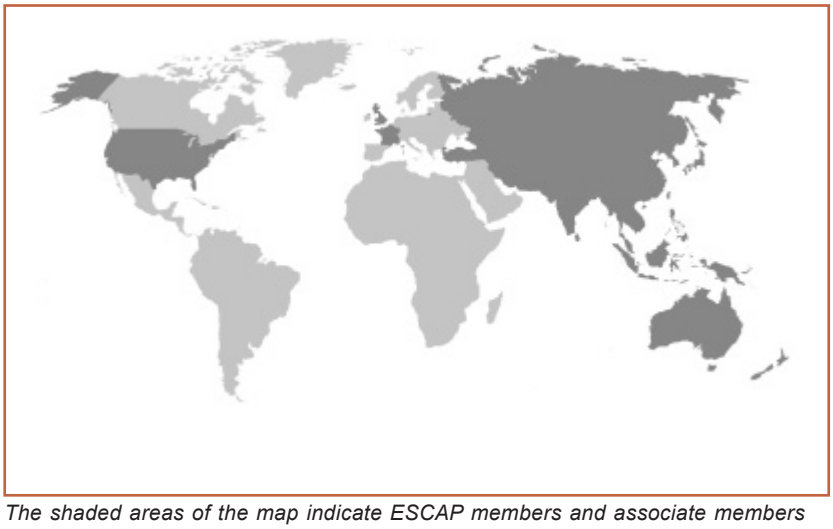
APCTT
Asian and Pacific Centre for Transfer of Technology

UNITED NATIONS ESCAP
Economic and Social Commission for Asia and the Pacific

The **Asian and Pacific Centre for Transfer of Technology (APCTT)**, a subsidiary body of ESCAP, was established on 16 July 1977 with the objectives: to assist the members and associate members of ESCAP through strengthening their capabilities to develop and manage national innovation systems; develop, transfer, adapt and apply technology; improve the terms of transfer of technology; and identify and promote the development and transfer of technologies relevant to the region.

The Centre will achieve the above objectives by undertaking such functions as:

- Research and analysis of trends, conditions and opportunities;
- Advisory services;
- Dissemination of information and good practices;
- Networking and partnership with international organizations and key stakeholders; and
- Training of national personnel, particularly national scientists and policy analysts.



The shaded areas of the map indicate ESCAP members and associate members

Cover Photo

Fungus growing on the bark being used to clean oil-polluted soil

(Credit: http://phys.org / Aalto University, Finland)

VATIS* Update
Waste Management
is published 4 times a year to keep the readers up to date of most of the relevant and latest technological developments and events in the field of waste management. The Update is tailored to policy-makers, industries and technology transfer intermediaries.

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Global e-scrap market

A report from Transparency Market Research (TMR) has predicted that the value of the global e-scrap recycling market will climb to US$ 34.32 billion by 2022. This would represent an annual growth rate surge of more than 15%, with Europe maintaining its position as market leader. In 2014, Europe accounted for around 29% of the overall electronic scrap recycling market. However, the Asia-Pacific region is expected to witness the fastest growth during the forecast period. Especially countries like China, Japan, South Korea, India, Australia and Singapore offer several growth opportunities for the electronic scrap recycling market.

The report concludes that large white goods accounted for the biggest volume share (roughly 50%) of the e-scrap generated worldwide in 2014. However, the small home appliances market is expected to experience the most growth by 2022. TMR believes that the precious metals segment will record a compound annual growth rate of 11.2% and that smelting and refining companies such as Boliden Group, Umicore and Mitsubishi Materials USA Corporation will significantly increase their e-scrap processing capacities. The report highlights that as much as 50 million tonnes of e-scrap is generated annually around the world.

Source: http://www.recyclinginternational.com

Indonesia to generate energy from waste

The government of Indonesia has issued Presidential Regulation No. 18 of 2016 on waste-based power plants to accelerate the plan to process waste into energy. "Remove trash from cities, and utilize it to generate electricity as a bonus," the ministrys DG for New and Renewable Energy and Energy Conservation, Rida Mulyana, stated. Mulyana emphasized that globally, the waste problem was linked to social issues, health, and the environment, for instance, related to garbage, which was the source of pollutants.

So far, he noted that various parties had spent a significant amount of time to manage waste, and the waste problem was also brought into the political sphere. Further, Mulyana added that the government was committed to reducing carbon dioxide emissions and delivering three programs: the reform of subsidy, accelerated utilization of new and renewable energy, and the acceleration of the "waste-to-energy" program. The Indonesian government is seriously pushing this program, and the regulation is complete. The coordinating ministry has issued the derivative regulation.

Source: http://www.antaranews.com

Fiji's waste management strategy

The Fiji's Ministry of Local Government, Housing and Environment has begun consultations on the development of the National Waste Management and Pollution Control Strategy 2016 – 2025. The first workshop to launch the consultation process was held at De Vos on the Park on 21st April, 2016 and was attended by stakeholders from the public and private sector across Fiji.

Ministry of Local Government, Housing and Environment permanent secretary, Mr Joshua Wycliffe, said that the purpose of the National Waste Management and Pollution Control Strategy was to update and amalgamate the three outdated strategies; National Waste Management Strategy 2011-2014, National Liquid Waste Management Strategy 2006 and the National Air Pollution Control Strategy 2007 into one strategy.

The new strategy will align with the Environment Management Act 2005 and the Environment Management Regulations 2007 bringing greater regulating and enforcement of the existing permit system and that monitoring and reporting of emissions to air, land and sea will required by the operators and businesses. The new National Waste Management and Pollution Control Strategy is one more step towards a cleaner environment which the government is committed to.

Source: http://www.fijisun.com.fj

Viet Nam launches POPs project

Vietnam's Ministry of Natural Resources and Environment (MONRE) has launched a 3-year project to manage persistent organic pollutants (POPs), mercury and hazardous chemicals. It aims to reduce emissions of, and exposure to, these substances by developing and implementing a policy framework to safely manage chemicals, including POPs and persistent toxic substances (PTS); monitoring and reporting on POPs and PTS; managing contaminated areas; and compiling an inventory of data on national emissions of mercury.

MONRE will provide assistance to draft, amend and promulgate new regulations and technical guidelines on the safe management of chemicals in the environment; manage contaminated areas by assessing and containing risks; and meet the requirements of the international conventions in which

Vietnam participates, such as the Stockholm Convention.

Source: https://www.chemicalwatch.com

China plans to tackle soil pollution

At the bi-monthly session of the Standing Committee of the National People's Congress (NPC), held on 25th April in China, the minister of environmental protection Chen Jining said that the country would introduce a plan aimed at soil protection and pollution control. He announced that a nationwide soil pollution study would be conducted. The study will mainly focus on lands used for farming and construction purposes. A database on basic soil conditions across the country will also be established.

These plans have received significant support. The Ministry of Finance recently announced that it had appropriated 9.09 billion yuan (US$1.40 billion) to establish a special fund for soil protection, a 145.6% increase as compared with the money invested in the field last year. China will take a series of actions to tackle soil pollution after a national environmental watchdog reported its work to the country's top lawmakers.

Source: http://www.china.org.cn

India set rules for hazardous waste disposal

The Indian Environment ministry has announced the new Hazardous Waste Rules to resource recovery and disposal of hazardous waste. The new rules have banned the import of waste edible fats and oil of animals, or vegetable origin, household waste, critical care medical equipment, tyres for direct re-use purpose, solid plastic wastes including pet bottles, waste electrical and electronic assemblies scrap and other chemical wastes especially in solvent form. However, no ministerial permission will be required for import of metal scrap, paper waste and various categories of electrical and electronic equipment for re-use purpose.

As per the information furnished by Central Pollution Control Board (CPCB) in the year 2015, the total hazardous waste generation in the country is 7.46 million metric tonnes per annum from about 44,000 industries. The Rules also simplify a range of procedures to merge all the approvals as a single window clearance for setting up of hazardous waste disposal facility and import of other wastes. There is emphasis on the necessity of infrastructure to safeguard the health and environment from waste processing industry has been prescribed as Standard Operating Procedure (SOPs) specific to waste type.

The Rules also stipulate that states must allot industrial space or sheds for recycling, pre-processing and utilization of hazardous waste; register the workers involved in recycling, pre-processing and other utilization activities and ensure safety and health of workers. State Pollution Control Board are mandated to prepare an annual inventory of the waste generated; waste recycled, recovered, utilised including co-processed; waste re-exported and waste disposed and submit to the CPCB by the 30th day of September every year.

Source: http://www.economictimes.indiatimes.com

India generates 18.5 lakh tonnes e-waste

According to a joint-study done by Assocham and Frost and Sullivan, India generates about 18.5 lakh metric tonnes (MT) of electronic waste every year, with Mumbai and Delhi-NCR accounting for the biggest chunk. Also, the figure is likely to reach up to 30 lakh MT per year by 2018, growing at the rate of 25 per cent. Mumbai, with 1,20,000 MT has topped the list in generating e-waste followed by Delhi-NCR producing 98,000 MT and Bengaluru producing 92,000 MT. Besides, Chennai with 67,000 MT of e-waste, Kolkata 55,000 MT, Ahemdabad 36,000 MT, Hyderabad 32,000 MT and Pune 26,000 MT have made to the list.

Just 2.5 per cent of India's total e-waste gets recycled due to poor infrastructure, legislation and frame work, the study said that this has lead to a waste of diminishing natural resources, irreparable damage of environment and health of the people working in industry. Over 95 per cent of e-waste generated is managed by the unorganised sector and scrap dealers in this market, dismantle the disposed products instead of recycling it. Further, the study strongly advocates legislation to prevent a child's entry into this kind of labour which includes collection, segregation and distribution.

E-waste comprises computer equipment (about 70 per cent), followed by telecommunication equipment (12), electrical equipment (8) and medical equipment (7). Other equipment, including household e-crap account for the remaining, it said. The government, public and private industries contribute over 70 per cent of e-waste, while 15 per cent comes from households. Televisions, refrigerators and washing

machines make up the majority of e-waste generated, while computers make up to 20per cent and mobile phones 2 per cent.

Source: http://www.business-standard.com

Bio-medical waste management rules in India

The government of India has notified new bio-medical waste management rules, bringing in its ambit vaccination camps, blood donation camps, surgical camps or any other health-care activity which generates hazardous medical waste. The rules also make provisions for phasing out the use of chlorinated plastic bags, gloves and blood bags within two years and establishing a 'Bar-Code System' for bags or containers containing bio-medical waste for disposal. The bar-coding system will help the government agencies in proper monitoring of movement of waste containers from generating points to treatment facilities.

It also prescribes more stringent standards for incinerator to reduce the emission of pollutants in environment. At present, 484 tonnes per day (TPD) of bio-medical waste is generated from 1,68,869 health-care facilities (HCFs) in the country. Total 447 TPD out of 484 TPD of such waste is treated. There are 198 common bio-medical waste treatment facilities (CBMWF) in operation and 28 are under construction in different parts of the country. Under the new rules, state governments will have to provide land for setting up common bio-medical waste treatment and disposal facility.

Source: http://www.timesofindia.indiatimes.com

Sri Lanka to tackle marine pollution

The Republic of Korea is to help Sri Lanka tackle its worsening marine pollution, especially from plastic waste and industrial effluent, which can affect fisheries and tourism. A study on the sources and impact of marine debris in Sri Lanka is to be done by surveying marine debris on the beach and underwater. Health Minister Rajitha Senaratne said the Cabinet of Ministers has approved a project proposal under which Expo 2012 YEOSU Korea Foundation, which works to support sustainable development, will help with the study.

It will be done through an agreement with Sri Jayawardenepura University and the Marine Environmental Protection Authority to ensure sustainable fisheries and tourism. The project will help to establish a policy to cope with marine debris, help Sri Lankan scientists to use equipment to survey marine debris and develop educational material to educate the public. Recent studies show the amount of plastic waste that gets into the sea from Sri Lanka each year is 240,000-640,000 tonnes.

Marine debris, which mostly comes from land-based activity, can travel the whole world with ocean currents and wind. Other studies have shown alarming levels of heavy metal accumulation in edible species in coastal water bodies like the Negombo lagoon and Bolgoda Lake believed to be originating from nearby industrial zones like Katunayake and Ekala and municipal sources.

Source: http://www.economynext.com

Project launched to make Pakistan pollution-free

An innovative Clean Pakistan Project, supported by Prime Minister's Youth Programme, has been launched to make the country pollution-free. Under the programme, a Waste Busters concept is being introduced which can generate about 15,000 jobs and give birth to an entire new industry in the country. The concept will employ qualified and eligible Ecopreneurs to implement the programme at local Union Council level.

Waste Busters, a private waste management company operating in Pakistan, sorts and recycles collected waste and uses it as compost, soil, conditioners, fertilizers, refuse-derived fuel (RDF) and as repurposed furniture. Pakistan generates over 50,000 tons of garbage every single day of which 40 percent is not even collected and it winds up in streets and open areas. This programme, will get up to Rs. 2 million loan from National Bank.

The loan will have to be repaid at a discounted interest rate of 6 % over a period of 8 years. The repayment will be delayed by a year to provide some time for businesses to be established. The individuals, who get selected, will be trained and supported by Waste Burners to establish their business franchise. The amount received in loan would have to be used in initial capital investment which includes hiring employees, buying vehicles, tools, gear and personnel training expenses.

Source: http://www.dnd.com.pk

ewasteguide.info

A knowledge base for the sustainable recycling of e-Waste

Recyclable plastic stronger than ABS

Researchers at the Department of Energy's Oak Ridge National Laboratory (ORNL), the United States, have developed a recyclable thermoplastic that is significantly stronger than ABS (acrylonitrile, butadiene and styrene) by replacing styrene with lignin, a brittle, rigid polymer that, with cellulose, forms the woody cell walls of plants. The material, which its inventors call 'ABL', could prove to be a more sustainable alternative for use in ventilation pipes, protective headgear, kitchen appliances and many other consumer products that are currently fabricated from ABS.

"The new ORNL thermoplastic has better performance than commodity plastics like ABS," said Amit Naskar, of ORNL, who together with co-inventor Chau Tran has filed a patent application for the process to make the new material. To produce an energy-efficient method of synthesizing and extruding high-performance thermoplastic elastomers based on lignin, the ORNL team needed to determine which types of lignin had both the thermal and melt stability to make them good candidates as a thermoplastic feedstock. The researchers then needed to "toughen" the lignin by chemically combining soft matter with it to make it more ductile.

Next, the researchers experimented to determine whether controlling the processing conditions could improve the performance of the polymer alloy. For example, 33% acrylonitrile content produced a material that was stretchy but not strong, behaving more like rubber than plastic. At higher proportions of acrylonitrile, the researchers saw the materials strengthen because of the efficient interaction between the components. They also wanted to know at what temperature the components should be mixed to optimize the material properties. They found heating components to between 140 and 160 degrees Celsius formed the desired hybrid phase.

Source: http://www.insights.globalspec.com

Plastic-eating bacteria

Researchers at Kyoto University, Japan, have discovered a plastic-eating bacteria that could have a major impact on recycling efforts around the world. Similar research by Ambercycle Inc., the United States, has been rewarded with a 250,000-euro ($283,000) Global Change Award funded by the H&M Conscious Foundation, an arm of Stockholm, Sweden-based clothing retailer H&M. The Kyoto team has found a plastic-eating microbe after five years of searching through 250 samples of rubbish. They isolated a bacteria that could live on polyethylene terephthalate (PET), a common plastic used in bottles and clothing.

The team has named the new species of bacteria *Ideonella sakaiensis*. Unlike natural polymers, such as plant cellulose, plastics aren't generally biodegradable. The Conversation story notes bacteria and fungi co-evolved with natural materials, developing biochemical methods to harness the resources from dead matter. But plastics have been around for only about 70 years, so microorganisms haven't evolved to the point at which they can latch onto the plastic fibers, break them up, and then use the resulting chemicals as a source of energy and carbon that they need to grow.

The researchers more or less left the PET in a warm jar with the bacterial culture and some other nutrients, and a few weeks later all the plastic was gone. Second is that the team has identified the enzymes that *Ideonella sakaiensis* uses to breakdown PET. All living things contain enzymes that they use to speed up necessary chemical reactions. The Kyoto researchers identified the gene in the bacteria's DNA that is responsible for the PET-digesting enzyme, and were able to manufacture more of the enzyme and then demonstrate that PET could be broken down with the enzyme alone.

Source: http://www.advancedtextilessource.com

Bacterium that degrades and assimilates PET

A group of researchers comprising Assistant Professor Shosuke Yoshida, Associate Professor Kenji Miyamoto, Professor Emeritus Kohei Oda, and Professor Emeritus Yoshiharu Kimura, of Keio University Faculty of Science and Technology, Japan, conducted a collaborative research project with Teijin Limited, Japan, and ADEKA Corporation, Japan, have discovered a bacterium that degrades and assimilates polyethylene terephthalate (PET) and were able to identify the decomposition mechanism.

PET is used extensively throughout the world, commonly in clothing and plastic bottles. MostPET products simply end up in landfills, never entering a recycling process, and it was generally believed that PET is resistant to microbial degradation. However, the present research overturns certain aspects of this commonly accepted theory, and the findings are expected to contribute greatly to the development of bio-recycling technology of PET waste products. The results have

been published in the American science journal *Science*.

Source: http://www.scienceandtechnologyresearchnews.com

Energy efficient method to recycle tyres

Researchers at Durham University, the United Kingdom, have developed a method breaking down rubber in materials at room temperature. The chemical process uses catalytic disassembly, saving energy over processes requiring heating the rubber. The Durham researchers believe that their chemical process may be used to allow the materials to be recycled back into their original use – so a recycled tire could be made into a new tire. Their cross metathesis reaction breaks down rubbery polymers into viscous liquids that can then be reformed without degradation.

Previously this was not possible so the tires were broken down into fuel or small rubber particles added to building materials or used in road construction. The process discovered uses Grubbs' catalysts to break down polybutadiene (PBd) networks at their double bonds via cross-metathesis (CM) reactions to produce readily soluble molecules. As the chains fragment, the material disintegrates into rubber crumb at room temperature. Grubbs' catalysts are easily synthesized and readily-available commercially.

Grubbs' Catalysts are a series of transition metal carbene complexes used as catalysts for olefin metathesis. They are named after Robert H. Grubbs, the chemist who first synthesized them. There are two generations of the catalyst, as shown on the right. In contrast to other olefin metathesis catalysts, Grubbs' catalysts tolerate other functional groups in the alkene, are air-tolerant and are compatible with a wide range of solvents. For these reasons, Grubbs' catalysts have become popular in synthetic organic chemistry.

Source: http://www.revolution-green.com

Tire recycling yields steel, diesel, carbon

Tytec Recycling, Australia, has announced that it would open the world's first environmentally-friendly off the road tire recycling operation this year. The facility will employ a new Edison Award-winning technology to make high-quality marketable steel, diesel oil and carbon out of the old earthmoving tires used in mining and agriculture. "We're currently on track to begin OTR recycling in June 2016 and will open our purpose-built recycling center in Perth in January 2017, then Queensland soon after," said Brett Fennell, at Tytec Recycling.

Now, using Edison Award-winning technology from the Green Distillation Technologies Corporation (GDTC), Australia, Tytec Recycling will convert these outworn tires into steel, diesel oil and carbon. GDTC has developed a proprietary destructive distillation technology capable of recycling end-of-life tires of all varieties into saleable commodities of carbon, oil and steel. GDTC recovers up to 85 percent of the unused energy in an end-of-life tire in the form of carbon and oil without pre-processing and is completely emission free.

The only waste stream is heat. All products from the tire recycling process can be used. The oil can be used as a heat source, blended with fossil fuels, used to make carbon black, instead of fossil fuels or further refined into other usable hydrocarbon products. The carbon can be used as a heat source or an agricultural additive, the steel goes into the scrap steel market. There is a strong potential for using the waste heat in the generation of electrical energy, rendering the process entirely waste free.

Source: http://www.ens-newswire.com

Recyclable, sugar-derived foam

Researcher Marc A. Hillmyer and colleagues at the University of Minnesota, the United States, have developed an efficient method to make a sugar-derived rubbery polyester compound called poly (β-methyl-δ-valerolactone), or PMVL. Renewable and degradable, PMVL was found to be able to replace petroleum-derived polyols in making both new chemically-recyclable polyurethanes thermoplastic polyurethanes and flexible foams. Using this new polymer, the researchers made flexible polyurethane foams that were comparable in performance to commercial analogs.

To test whether the foams could be recycled, the team first added a catalyst, then heated the materials to a high temperature. Through this process, the researchers recovered up to 97 percent of the starting β-methyl-δ-valerolactone (MVL) monomer in high purity. The researchers then used what they recovered to re-make PMVL with essentially identical properties. This recycling strategy bypasses many of the technical challenges that currently preclude the practical chemical recycling of PUs. Funding for this research was provided by the National Science Foundation supported Center for Sustainable Polymers and the University of Minnesota.

Source: http://www.bioplasticsmagazine.com

Extraction of gold, copper from e-waste

Mahdokht Arshadi, a researcher from Islamic Republic of Iran, has recycled electronic waste using biological methods managing to recover gold and copper. "E-waste is a term for electronic products that have become unwanted, non-working or obsolete, and have essentially reached the end of their useful life and need to be recycled or buried. Normally, e-wastes are buried and due to containing harmful metals such as arsenic, mercury, cadmium or lead, upon burial they enter the human food chain and ultimately threaten human health," said Arshadi.

Arshadi highlighted that in addition to hazardous metals, e-wastes contain certain useful metals as well; "given that gold and copper mines are running out, e-waste marks a good supplying source as a result of containing more than 50 types of metals. By exploiting proper methods, the seemingly harmful e-waste can turn into an important alternative to important minerals which are coming to an end."

Arshadi further added that "we managed to recycle e-waste through a biological method exploiting two indigenous bacteria in order to extract gold and copper." Consisted of a two-step process on the basis of bio-leaching procedures, the new method is simple, inexpensive and environmentally friendly. The benefits of the newly-developed biological method including being cost-effective, producing a high rate of value-added as well as preventing environmental problems.

Source: http://www.en.mehrnews.com

Precious metals from e-waste

A team of researchers from National University of Singapore (NUS) has discovered that electronic waste is not just a load of garbage. Instead, precious metals such as gold, platinum and palladium can be safely and sustainably recovered from electronic waste. Working together with international collaborators, NUS Synthetic Biology for Clinical and Technological Innovation (SynCTI) researchers found that synthetically engineered microbes can be used to recycle the precious metals. The process, the first such attempt in using synthetic biology for recycling of metals from electronic waste, was developed over a period of three years.

Electronic waste represents a growing portion of unwanted materials in modern cities, posing a major disposal challenge. This presents a pressing need to recycle in order to protect the environment and conserve natural resources. "Ultimately, we can't continue to mine precious metals such as gold from ores as we'll run out of these natural resources, so all these circulating metals have to be recovered," said Associate Professor Yew Wen Shan, at NUS. Supporting this call to recycle is the fact that electronic waste contains a higher concentration of gold compared to gold ores which typically contain other fillers.

The method recovers precious metals, and removes toxic ones such as lead and mercury, in a greener and more sustainable way. Within a bioreactor, the team synthetically engineered a soil bacterium known as Chromobacterium violaceum to produce a biochemical derived from the amino acid glycine. The biochemical oxidises the electronic waste in place of harsh acids used conventionally. Subsequently, another class of engineered enzymes is expressed for biological reduction, effectively substituting electrolysis.

Source: http://www.news.nus.edu.sg

Bacteria to recover metals

A team of researchers led by Antonio David Dorado, Montserrat

Electronic waste and recycled gold with the bioreactor.

Solé and Xavier Gamisans at the Department of Mining, Industrial and ICT Engineering (EMIT) of the Universitat Politècnica de Catalunya (UPC), Spain, are exploring the potential of bioleaching as a technique for recovering metals from electronic waste from mobile phones. The technique could easily be adapted for use with other kinds of electronic waste, such as televisions, computers and refrigerators. 'Bioleaching', a process in which microorganisms feed on the metal in the circuit boards of mobile phones to eliminate what has no value and recycle recoverable metals.

The process involves putting electronic waste containing metals of interest – copper, gold, chromium, zinc, nickel and aluminium, among others – in contact with iron-oxidising bacteria to extract the metals for reuse. Instead of chemically attacking the waste, the process harnesses the oxidising ability of some microorganisms. The extraction agents used are regenerated, and use of reagents and high temperatures is reduced. The process is starting to be used with printed circuit boards from mobile phones, but experts say it could easily be adapted for use with other kinds of electronic waste, such as televisions, computers and refrigerators.

The most commonly used bacterial species, Acidithiobacillus ferrooxidans, grows in very adverse (and uncommon) conditions. It is found in nature in environments such as urban waste water. The researchers collected samples from such environments and treated them in a laboratory under conditions designed to ensure that only this species would survive and reproduce. Other microorganisms and communities that are generating good results within a reasonable time frame are also being investigated. At this point, the researchers are trying to work out how the extraction process can be improved to make it viable for industrial use.

Source: http://www.upc.edu

Recycling of smartphone lithium ion batteries

Researchers at Kyung Hee University (KHU), Republic of Korea, have proposed a model to recycle smartphone lithium ion batteries into solar power systems – providing both energy and economic growth for rural communities. Boucar Diouf, at KHU, has described the logistics of his recycling and repurposing program in the *Journal of Renewable and Sustainable Energy*. "The proposed program consists of five general steps – battery collection, testing and selection, system manufacturing, commercialization, and installation. Each of these steps would provide opportunities for job creation," said Diouf.

The candle and kerosene lamps used to light the homes within many rural communities are harmful, inefficient and more expensive than a small solar home lighting system, provided the right approach is taken. "Using the battery of mobile phones in small solar home systems becomes obvious in order to make access to electricity easier to those who live without," added Diouf. A standard lithium ion phone battery of 1000 milliamp-hour capacitycan power a one-watt LED lamp for about three hours, or a 0.5-watt lamp – bright enough for reading and writing – for about six hours.

When wired to a small solar panel, this maintenance-free system can last for approximately three years. The researchers also constructed a full 12-volt system made of three mobile phone batteries of 3100 millliamp-hour capacity each, with a 5-watt LED lamp and a small solar panel, for less than $25. These systems have the capability to light up a room for about five hours each day, and can last for approximately three years without any maintenance.

Source: https://www.publishing.aip.org

Car battery recycling

The United States Advanced Battery Consortium – a collaborative organisation of Ford Motor Company, General Motors and Fiat Chrysler Automobiles – has been awarded a US$ 2.2 million contract to researchers to establish a new lithium-ion battery recycling process. The initiative also aims to produce new plug-in hybrid electric vehicle (PHEV) battery cells using the recovered cathode materials.

The 2-year project will be conducted at Worcester Polytechnic Institute (WPI), the United States. Laboratory studies so far have allowed the researchers to recycle up to 80% of the cathode materials from unsorted batteries using this process, says WPI's Yan Wang, who leads the innovative endeavour. The process he developed requires virtually no sorting.

In the process, the batteries are shredded and the steel, aluminium, iron, copper, and plastics are recovered and recycled. The cathode materials are recovered and then used to synthesize new cathodes.

Source: http://www.recyclinginternational.com

Microbots to remove lead from wastewater

An international research team led by the Max-Planck Institute for Intelligent Systems (MPI-IS), Germany, have designed graphene-based microbots, 15-20 microns long, that can reduce lead contamination from wastewater by 95%, promising a novel method for cleaning up industrial pollution. Researchers say that a swarm of hundreds of thousands of the microbots can clean water containing 1,000 ppb of lead down to below 50 ppb in 60 minutes. They also say the new proof-of-concept microbots are ten times more efficient than their previous generation of microbots.

The tube-shaped microbots have three functional layers: The outer layer, made of graphene oxide captures the lead contaminants. The middle layer made of nickel is ferromagnetic, which allows the microbots to be controlled and retrieved using a magnetic field. The inner layer consists of platinum, which breaks down hydrogen peroxide, which is added to the contaminated water. The produced water and oxygen microbubbles are ejected from the back of the microbot, thus allowing the microbots to self-propel through the water.

Once the microbots have reached their absorbing capacity, they are collected and treated with an acidic solution to remove the lead ions. The microbots can be reused after the treatment, and the treated lead in solution can also be recovered and reused. The researchers foresee a future where the swarm of microbots can be controlled by an automated magnetic system. The next step for the team involves extending the microbots to capture other contaminants and reducing the fabrication costs in order to mass-produce the thousands of individual robots required for industrial-scale treatment projects.

Source: http://www.thechemicalengineer.com

Method for selective metal remediation

Researchers at Oak Ridge National Laboratory (ORNL), the United States, recently announced that they had found new ways to influence selectivity for specific charged ions. As a result, the researchers claim that utilization of the discovery would improve environmental clean-ups. The ORNL researchers found new ways to influence selectivity for specific positively charged ions (cations) with the addition of simple receptors, not for cations but rather for negatively charged ions (anions). This discovery, which provides a new twist on selectivity, proves that adding an anion receptor can affect the selectivity of extractants used to separate metals.

Better selectivity via the addition of anion receptors to enhance discrimination between metals, such as sodium and cesium, could improve future environmental cleanup efforts. “This is the first instance of using an anion receptor to enhance selectivity for a cation. “The basic research shows that you can modify the selectivity of an extractant using an anion receptor. This proof of principle could have future broader implications in removal of contaminants like cesium from ocean water, groundwater or nuclear waste in storage tanks,” said Neil Williams at ORNL.

Source: http://www.hazmatmag.com

Phytoremediation of textile industry effluent

Researchers from Kuvempu University, India, have carried out a study which deals with a laboratory experiment on the usage of Salvinia molesta, Pistia stratiotes and Azolla pinnata in the removal of some heavy metals from ETCO Denim Pvt Ltd, Bijapur Company. It was observed that Pistia stratiotes removed more percentage of Nitrates, Salvinia molesta exhibited maximum percentage reduction for Manganese and Azolla pinnata was able to remove Sulphate from the effluent. The experimental study showed that these plants are suitable for effective removal of heavy metals.

The phytoremediation using aquatic plants is very effective and ecofriendly technology in the treatment of industrial effluents. This work revealed that the selected aquatic macrophytes are highly efficient in absorbing most of the pollutants from the effluent thereby reducing the pollution load. The plants are more efficient in removing the pollutants at 25% concentration of the effluent. Pistia and Salvinia were found to reduce the color of the effluent as compared to Azolla. Heavy metals Copper, Manganese, Iron, Nitrate and Phosphates are the major contaminants in the textile effluent.

The study explores the fact that textile industries discharged effluent having heavy metal used in various dyeing and printing processes that is toxic to the aquatic life. Pistia stratiotes, Salvinia molesta and Azolla pinata were found to play a comparatively key role in removal of heavy metals. It was observed that Pistia stratiotes removed more percentage of Nitrates, Salvinia molesta exhibited maximum percentage reduction for Manganese and Azolla pinnata was able to remove Sulphate from the effluent. The research findings have been published in *International Journal of Environmental Sciences.*

Source: http://www.crdeep.com

Adsorption of Chromium Ion

A study done by a team of researchers from Kwara State University, University of Ibadan and College of Health Sciences and Technology, Nigeria, have assessed the use of plantain (*Musa paradisiaca*) wastes in the biosorption of chromium from battery recycling effluent. Plantain wastes were collected from a plantation, sun-dried and ground. These were then carbonized and activated using phosphoric acid at high temperature. Samples of effluent from Ogunpa River were subjected to physico-chemical (pH, conductivity, Total Dissolved Solid (TDS) and Chromium (Cr)) analyses, using standard methods.

Batch experiment studies were used in determining the adsorption isotherms of the adsorbents at varied effects of pH (2 to 12) and adsorbent doses (0.1 to 2.0g) with treatments by plantain prepared activated carbons. Data was analysed using descriptive statistics, paired t-test and ANOVA at 5% level of significance. Means of pH, conductivity, TDS and Cr^{+6} of the effluent sample were: 2.0 ± 0.2, 2164.7 ± 0.6 µs/cm, 895 ± 0.00 mg/l and 13.5 ± 0.0 mg/l respectively. The highest quantities (68.02%) of Cr were removed at pH 10 while the optimum adsorbent dose (2.0g) removed 68.91% of Cr.

The adsorbents showed satisfactory fits of adsorption to Langmuir and Freundlich models. Adsorbents had capacity for the uptake of chromium from effluent generated from battery recycling plant with plantain peel activated carbon having the highest adsorption capacity. Conversion and treatment of effluent with plantain wastes should be encouraged in battery recycling plant, to reduce its menace in the environment and promote effective waste management.

Source: http://www.pubs.sciepub.com

Wastewater treatment by adding algae

A team of researchers at Drexel University, the United States, have developed a "bioreactor" system which is able to remove several chemicals from wastewater at once, shortcutting a process that, in conventional sewage treatment, takes multiple steps, expensive ingredients and quite a bit of time. Christopher Sales, at Drexel, is trying to improve wastewater treatment by adding algae – think pond scum – to the activated sludge where nitrogen is removed.

Sales said that "one of the most time-consuming and expensive components to wastewater treatment today is ridding water of nutrients such as nitrogen and phosphorus, which often make their way into water from our household toilets and sinks. It's an essential step, because the release of excess nitrogen...into a water supply can lead to accelerated growth of cyanobacteria and algae." The process uses a significant amount of energy, because oxygen has to be pumped through the wastewater to drive the conversion of ammonium to nitrate.

Similarly, wastewater treatment plants often need to add chemicals, such as methanol, to provide denitrifying bacteria with enough food to transform the nitrate into nitrogen gas. But Sales's bioreactor works by continuously cycling water through an environment heavily populated with algae and bacteria. It removes nitrogen by storing it in algae that can easily be separated from water in the new reactor. According to Sales, his process can remove up to 80 per cent of nitrogen from a waste stream.

Source: http://www.dailycommercialnews.com

New technology of oil spill recovery

Researchers Seoul National University, Republic of Korea, have developed a new technology to refine spilled oil on sea. A team led by Professor Kim Yong-hyeop has succeeded in developing a high-efficient technology by using graphenes, touted as a next-generation material, to recover spilled oil in almost 100 percent purity.

The research team developed a graphene-structure equipment, which absorb only oil from polluted waters. This device can recover oil by using a capillary tube without a separate engine power, and can absorb 20,000 liters of oil per hour with a 1 square meter size.

The previous oil fence can absorb oil up to 80-90 percent of purity meaning other substances were also recovered. But the newly developed equipment by the Korean research team can absorb oil in 99.9 percent purity so that oil can be reused without being refined. The research results have been published in science journal *Scientific Reports*.

Source: http://www.english.donga.com

The Step Initiative

Step is an international initiative comprised of manufacturers, recyclers, academics, governments and other organizations committed to solving the world's e-waste problem.

For more information, access:

http://www.step-initiative.org

Removing heavy metals from pharmaceutical effluent

A team of researchers from the Islamic Azad University (IAUPS) and Tehran University of Medical Sciences, Islamic Republic of Iran, have determined the accumulation of heavy metals in *Plarganium grandiflorum* grown in chemical and toxicology laboratories' pharmaceutical effluent and wastewater irrigated soil in the vicinity of sewage treatment plant (STP), Tehran. The results revealed that wastewater was highly rich in plant nutrients and heavy metals. The wastewater irrigation significantly ($P<0.05/P<0.01$) increased the contents of heavy metals in the soil and plants grown in wastewater irrigated soil.

The enrichment of various metals were recorded in the order of Fe >Zn > Pb >Cu > Cd > Cr > Mn in these plants. Moreover contents of different heavy metals in the different parts of plants such as root and stems showed significant ($P<0.05$) and positive correlation with contents of Cd ($r = +82$ to $r = +96$), Cr ($r = +74$ to $r = +94$), Cu ($r = +84$ to $r = +98$), Fe ($r = +88$ to $r = +98$), Mn ($r = +80$ to $r = +96$), Pb ($r = +74$ to $r = +96$) and Zn ($r = +88$ to $r = +98$) in the wastewater irrigated soil. Although, the contents of Cd, Cu, Fe, Mn, Pb and Zn in soil after growing of *Plarganium grandiflorum* after 60 days were recorded within the prescribed limit of WHO/FAO standards.

Pelargonium (Grandiflorum) has shown ability to extract lead, Cr (III), Cr (VI) and Cd from contaminated soils; about 35.9%, 41.9%, 41.7% and 29.8% respectively in the root and leaves zone. To quantify the occurrence and the distribution of heavy metals and to prevent them from passing through wastewater collection and treatment systems into soil and ground water bodies represents an urgent task for applied environmental sciences in the coming years. The responsible organizations should stimulate research to upgrade existing waste water treatment by implementing phytoremediation modules and demonstrating their reliability to the public.

Source: http://www.biomedpharmajournal.org

Enzymes to clean up the environment

At the American Chemical Society national meeting, held on 13-17 March in San Diego, USA, researchers reported a way to protect bioremediation enzymes by packaging them in a protein cage. Shaily Mahendra, an environmental engineer at the University of California, Los Angeles, (UCLA), the United States, who led the team, pointed out that bioremediation isn't a new process engineers invented. Nature has always been cleaning up messes in the environment with organisms that repurpose molecules excreted by others. "If it weren't for bioremediation, we'd be sitting on mountains of dinosaur waste right now," said Mahendra.

Engineers have exploited this natural process for various environmental clean-up jobs. For example, crews added fertilizers to Alaskan beaches to get soil bacteria to consume oil spilled by the Exxon Valdez. In the new work, the team put the enzyme manganese peroxidase inside vault particles. Peroxidases are known to oxidize and break down organic contaminants. The researchers modified the gene for the peroxidase so that when cells synthesized the enzyme it had an added domain that helped the enzyme bind to the inside of the vault particles. The team used insect cells to produce the vault components, as well as the modified enzyme.

The particles enhanced the peroxidase's activity in lab tests involving contaminants in solution. After 24 hours, the vault-packaged peroxidase consumed >90% of bisphenol A, a contaminant from plastic production, while the free enzyme broke down just 40%. Also, compared with free enzyme, the packaged peroxidase was more stable between 20°C and 40°C. So far the UCLA team has tested the particles on just a handful of contaminants, but Mahendra would like to eventually work with other enzymes that can break down different classes of pollutants, as well as test the strategy under field-like conditions.

Source: http://www.acssandiego2016.cenmag.org

Keeping Antarctica clean

Chemical engineers are using trenches and micro-organisms to help clean the frozen continent. Now, a team of engineers from the University of Melbourne (UM), Australia, is working to rectify this environmental damage. Dr Kathryn Mumford and her team have been working at Casey Station over the last decade on a project that uses chemical engineering processes to clean up fuel spillages and restore the Antarctic soil.

The team is using bioremediation techniques, in which naturally occurring micro-organisms are prompted – with the use of nutrients and oxygen – to degrade the

fuel and break down the contaminants. One method the researchers have successfully employed is the use of permeable reactive barriers; trenches filled with reactive material that intercepts the fuel plume, captures the contaminant and stimulates micro-organisms within it to break down the fuel, thus remediating the soil and groundwater.

"Our work over the last 10 years in developing permeable reactive barrier designs suitable for Antarctic conditions has been highly successful. We have proven that the technology can be applied with confidence of the remediation outcomes. There are currently six operational permeable reactive barriers at Casey Station, with further installations planned for the coming season. Our work has also been incorporated into the Antarctic Clean-up Manual presented to the Antarctic Treaty Consultative Meeting held in 2015," said Dr Mumford.

Source: https://www.pursuit.unimelb.edu.au

Bioremediation of hexavalent chromium pollution

In a study, researchers from Xiamen University, China, Shanghai Jinshan District Center for Disease Control and Prevention (SCDC), China, and Xiamen Medical School, China, have isolated bacteria for Cr(VI) bioremediation from sediment samples and to optimize parameters of biodegradation. Strains with the ability to tolerate Cr(VI) were obtained by serial dilution and spread plate methods and characterized by morphology, 16S rDNA identification, and phylogenetic analysis.

Cr(VI) was determined using the 1,5-diphenylcarbazide method, and the optimum pH and temperature for degradation were studied using a multiple-factor mixed experimental design. Statistical analysis methods were used to analyze the results. Fifty-five strains were obtained, and one strain (Sporosarcina saromensis M52) having the ability to tolerate 500 mg Cr(VI)/L was selected to optimize the degradation conditions.

M52 was found be able to efficiently remove 50-200 mg Cr(VI)/L in 24 h, achieving the highest removal efficiency at pH 7.0-8.5 and 35°C. Moreover, M52 could completely degrade 100 mg Cr(VI)/L at pH 8.0 and 35°C in 24 h. The mechanism involved in the reduction of Cr(VI) was considered to be bioreduction rather than absorption. The strong degradation ability of *S. saromensis* M52 and its advantageous functional characteristics support the potential use of this organism for bioremediation of heavy metal pollution.

Source: http://www.besjournal.com

Moringa oleifera seeds for bioremediation of soil

Researchers from National Research Institute for Chemical Technology (NARICT), Michael Okpara University of Agriculture (MOUAU), and Ahmadu Bello University (ABU), Nigeria, have investigated the potential of using *Moringa oleifera* seed cake to increase the rate of the microbial degradation of crude oil-spilled soil. The investigation was carried out at NARICT, within a period of 28 days. The proximate analysis of *Moringa oleifera* seed cake was found to contain nitrogen (10.55%), phosphorus (18.33 ppm) and organic carbon (1.06%). Likewise hydrocarbon degrading bacteria were isolated using spread plate method.

The results revealed that the counts of crude oil degrading bacteria in crude oil polluted soil amended with *Moringa oleifera* increased to 3.6 x 106 CFU/g, with a growth rate constant of 0.06 as compared with that of unamended polluted soil, whose counts increased to1.5 x 106 CFU/g, with a growth rate constant of 0.019. *Moringa oleifera* seed cake was found to enhance the degradation in crude oil polluted soil compared to unamended crude oil polluted soil by 64.3% pH of crude oil polluted soil sample amended with *Moringa oleifera* seed cake ranged between 7.24 and 7.70 while that of unamended crude oil polluted soil ranged between 7.24 and 7.44.

This implies that *Moringa oleifera* has a buffering effect which enables micro-organisms to proliferate. Statistical analysis showed no significant difference ($p>0.05$) between rate of biodegradation of crude oil in soil amended with *Moringa oleifera* seed cake as against that of unamended crude oil polluted soil. The results of this study show that *Moringa oleifera* seed cake is suitable for bioremediation of crude oil polluted soils. The research has been published in *British Journal of Applied Science & Technology (BJAST).*

Source: http://www.search.proquest.com

Project to Reduce POPs Emissions in East and Southeast Asia

The project demonstrates best available techniques and practices in open burning activities in response to the Stockholm Convention on POPs.

For more information, contact:

Carmela Centeno
UNIDO Project Manager
E-mail: c.centeno@unido.org

Clean technology to limit styrene emissions

Exel Composites, Finland, has completed a four-year project called Next Air Biotreat that explored biotrickling filtration as a way to limit styrene emissions. Exel Composites collaborated with the University of Valencia, Spain, and Pure Air Solutions, the Netherlands, to explore biotrickling filtration.

"Biotrickling filtration is a combination of a biofilter and a bioscrubber. It is a biological system that uses clean and natural processes to remove VOCs [volatile organic compounds]. The styrene fumes are absorbed in water and decomposed by bacteria. The pilot unit erected at [our Oudenaarde, Belgium] factory proved to be very efficient. We will certainly do the necessary investments to take this process into use," said Eric Moussiaux, at Exel Composites.

Professor Carmen Gabaldón from the University of Valencia, who led the project, believes the project was a success. "We are extremely pleased with the results of the project. In comparison with conventional technologies, biological VOC treatment is economically beneficial, it contributes to a lower ecological footprint and implies a reduction of carbon dioxide (CO_2)", Gabaldón said.

Source: http://www.compositesmanufacturingmagazine.com

Carbon dioxide turned into concrete

A team of researchers at University of California, Los Angeles (UCLA), the United States, has been working on a unique solution that may help eliminate these sources of greenhouse gases. Their plan would be to create a closed-loop process: capturing carbon from power plant smokestacks and using it to create a new building material – CO2NCRETE – that would be fabricated using 3D printers. That's 'upcycling'. "What this technology does is take something that we have viewed as a nuisance – carbon dioxide (CO_2) that's emitted from smokestacks – and turn it into something valuable," said J.R. DeShazo, professor at the UCLA.

Thus far, the new construction material has been produced only at a lab scale, using 3-D printers to shape it into tiny cones. "We have proof of concept that we can do this. But we need to begin the process of increasing the volume of material and then think about how to pilot it commercially. It's one thing to prove these technologies in the laboratory. It's another to take them out into the field and see how they work under real-world conditions," added DeShazo. This technology could change the economic incentives associated with these power plants in their operations and turn the smokestack flue gas into a resource countries can use, to build up their cities, extend their road systems.

Source: https://www.sciencedaily.com

Special material to capture carbon dioxide

New Mexico State University (NMSU) researchers Nasser Khazeni and Rolston St. Hilaire in coordination with Abbas Ghassemi, Reza Foudazi and Jalal Rastegary have developed a special material that can capture carbon dioxide (CO_2) with greater capacity than any technology currently in use. CO_2 capture has the potential to significantly cut CO_2 emissions worldwide.

According to Khazeni, global warming is something that is not just discussed at a conference. It's something that all people are now sensing. All the consequences like drought and floods are the things that have motivated me to do something to maybe help mitigate this global warming problem and its consequences. Khazeni later realized that if another researcher learned about his CO_2 capture technology they could patent it.

"We got to a point where we understood we had something that might have some commercial impact, and Ghassemi introduced us to Arrowhead to follow their route to protect our idea. We were very worried, especially when we understood that being published in a journal, it's not enough to protect it, especially if somebody else comes and gathers all the information and patents it. Then he's the one who owns that idea," Khazeni said.

Source: https://www.newscenter.nmsu.edu

Copper nanocrystals to improve CO_2 salvaging

Scientists from EPFL, Switzerland, have designed copper nanocrystals that can greatly improve our ability to turn waste carbon dioxide (CO_2) into useful hydrocarbons. Led by Prof. Raffaella Buonsanti at EPFL, exploited the ability of colloidal chemistry to produce tunable materials. The researchers synthesized two different sizes of copper nanocrystal spheres (7.5 nm and 27 nm in diameter), and, using the same colloidal chemistry-based method, three different

sizes of copper nanocrystal cubes (24 nm, 44 nm, and 63 nm).

Researchers then used the nanocrystals to explore how size and shape of affected the ability of copper to electroreduce CO_2 and to steer their reactivity towards different products such as methane or ethylene. They found that within each shape category (sphere or cube), the smaller nanocrystals show higher catalytic activity. But compared to the spheres, the cubic nanocrystals were more intrinsically active.

In addition, the lab found an unexpected trend, where the cubes with 44 nm side length showed an 80% selectivity for carbon products, 50% of which corresponded to ethylene, an important feedstock for petrolchemicals that can be utilized to produce materials like PET. Statistical analysis of surface atom density on the nanocrystals suggests that their edges play a key role for the CO_2 reduction reaction. The work has been published in *Angewandte Chemie*.

Source: http://www.actu.epfl.ch

Hybrid system to cut coal-plant emissions

Researchers at Massachusetts Institute of Technology (MIT), the United States, have come up with a plan that could contribute to that effort by making it possible to generate electricity from coal with much greater efficiency – possibly reaching as much as twice the fuel-to-electricity efficiency of today's conventional coal plants. This would mean, all things being equal, a 50 percent reduction in carbon dioxide emissions for a given amount of power produced. The key is combining into a single system two well-known technologies: coal gasification and fuel cells.

In the combined system, these gases would then be piped from the gasifier to a separate fuel cell stack, or ultimately, the fuel cell system could be installed in the same chamber as the gasifier so that the hot gas flows straight into the cell. In the fuel cell, a membrane separates the carbon monoxide and hydrogen from the oxygen, promoting an electrochemical reaction that generates electricity without burning the fuel. Because there is no burning involved, the system produces less ash and other air pollutants than would be generated by combustion.

It does produce carbon dioxide (CO_2), but this is in a pure, uncontaminated stream and not mixed with air as in a conventional coal-burning plant. That would make it much easier to carry out carbon capture and sequestration (CCS) – that is, capturing the output gas and burying it underground or disposing of it some other way – to eliminate or drastically reduce the greenhouse gas emissions. In conventional plants, nitrogen from the air must be removed from the stream of gas in order to carry out CCS. The concept is described in the *Journal of Power Sources*.

Source: http://www.news.mit.edu

Low-cost alloy to reduce CO_2 emissions

A team of researchers at the Department of Energy's Pacific Northwest National Laboratory (PNNL), the United States, cast an improved titanium alloy that can improve vehicle's fuel economy and reduce carbon dioxide (CO_2) emissions. During their study the researchers noted, an improved titanium alloy – stronger than any commercial titanium alloy currently on the market – gets its strength from the novel way atoms are arranged to form a special nanostructure.

The researchers examined this alignment and then manipulated it to make the strongest titanium alloy ever developed and with a lower cost process to boot. The material is an excellent candidate for producing lighter vehicle parts, and that this newfound understanding may lead to creation of other high strength alloys. Researchers used powerful electron microscopes and a unique atom probe imaging approach to examine the structure and once they understood the nanostructure, they created the strongest titanium alloy ever made.

This nanostructure of the alloy would help the auto industry build lighter vehicles that use less fuel and put out less carbon dioxide that contributes to climate warming, the researchers said. The team optimised the heat-treating process that makes alloy stronger to tailor the nanostructure and achieve very high strength. The finding has been published in journal *Nature Communications*.

Source: http://www.zeenews.india.com

Technology for carbon capture

A research project under the auspices of LEILAC (Low Emissions Intensity Lime and Cement) consortium, has announced a promising project regarding sustainable cement production: over the next five years, a cutting-edge testing facility is to be set up to rigorously assess new technology for the capture of carbon dioxide (CO_2). The research consortium includes HeidelbergCement, Germany, technology company Calix, Australia,and other cement and lime producers, as well as research and development institutions.

Calix entered the market two years ago with a reactor used to directly separate CO_2 from magnesium minerals. Now, the same technology is to be used to capture the CO_2 produced by the cement manufacturing process, two-thirds of which come as emissions from the burning (calcination) of limestone. The temperature necessary to drive out CO_2 from limestone, however, is significantly higher than needed for magnesium. Therefore, the Calix technology must be further engineered and intensively tested in the field.

The opportunities this technology will open up are tremendous: Integrated into the calcination process, the Calix reactor is capable of capturing almost pure CO_2 released from the limestone. The system is unique in that the heat of the exhaust gases is transferred to the limestone via a special steel vessel. In this way, the reactor is heated indirectly, with the gas never coming into contact with the limestone. The CO_2 released from the limestone can therefore be separated in an almost pure form. This technology offers an added benefit, as it can capture these emissions without significant energy or capital expenditures.

Source: http://www.heidelbergcement.com

Diesel engine concept cuts emissions

A research team at the New ACE Institute, Japan, has developed a new diesel combustion engine concept using multiple fuel injectors that doesn't require waste heat reduction. With a brake thermal efficiency of greater than 50 percent, the new engine could reduce engine manufacture costs. Waste heat recovery (WHR) is commonly used as a method of capturing the engine's heat to maintain a temperature in a particulate filter and other emissions control systems. WHR is relatively expensive, but aids the vehicle's overall efficiencies in both fuel use and emissions reductions.

The automotive research team at New ACE sought a way to optimize combustion that overcomes the complex tradeoffs between emissions, brake thermal efficiency (BTE) and energy losses on conventional diesel combustion. The team's engine utilizes three fuel injectors in a variant of the Sabathe cycle. This limited pressure, dual cycle controls heat by holding constant volume and pressure in the cylinder. The modification with this new concept is to control fuel injection to temporarily create an isolation between the premixed combustion area and diffusion combustion area of the cylinder, which enables consecutive heat release. This is accomplished by fitting the cylinder with three injectors. One is vertically mounted at the center and two more are positioned at an angle on either flank at the piston cavity's circumference. The side-angled sprays are directed along the swirl direction of the airflow, improving mixing and preventing spray interference and impingement on the cavity wall. This improves air mixing at the center of the cavity, which creates a more dense combustion point. Shaping of the piston cavity (crown) helps prevent injection interference between injectors.

Source: http://www.gizmag.com

New way to capture CO_2

A team of researchers has created CO_2 sorbents that are able to capture CO_2 in larger numbers and at higher stability than previous attempts. Getting rid of the use of liquid sorbents, the new study works with amines on a porous solid, a much more stable method. Scientists at the Tata Institute of Fundamental Research (TIFR), India, are leading new research that may offer a solution. They have designed functionalized nanomaterials that offer a much larger capacity for amine loading along with very little decline in surface area.

Dr. Vivek Polshettiwar, lead scientists of the newest study says the fibrous nanosilica (also known as KCC-1) is a very good candidate to be used in a more functional design with a better amount of capture capacity as well as kinetics and recyclability. The surface area of KCC-1 is high due to its fibrous morphology. Other materials that have been studied for CO_2 capture rely on their mesoporous channels.

KCC-1 boasts a very high amine loading, very minor decrease in both surface area and functionalization, along with amine sites with improved accessibility. So far CO_2 capture is a leading solution in the fight to reduce CO_2 levels that show no signs of slowing down. Other materials, such as SBA-15 have received a lot of attention for their large pores which are able to hold a wide variety of amine molecules and bigger surface areas, but they do not have the high number of textural properties found in KCC-1.

The study was published in the *Journal of Materials Chemistry* A and compares the new and conventional solutions for lowering the amount of CO_2 released into the atmosphere. Researchers continue to work on creating even better catalysts and sorbents with high sustainability.

Source: http://sciencenewsjournal.com

Coagulation and Flocculation in Water and Wastewater Treatment

The book provides a comprehensive account of coagulation and flocculation techniques and technologies in a single volume covering theoretical principles to practical applications. The book presents the subject logically and sequentially from theoretical principles to practical applications. Successive chapters deal with, in turn, properties of materials present in waters and wastewaters; characteristics and types of coagulants commonly in use; mechanisms and practical implications of destabilization of waterborne material using metal coagulants and polyelectrolytes.

Innovative Wastewater Treatment & Resource Recovery Technologies: Impacts on Energy, Economy and Environment

The main original approach of Innovative Wastewater Treatment & Resource Recovery Technologies is that the chapters dealing with technology include a conclusion section in which data can be fed into the Environmental Decision Support Systems and a mini-assessment is provided. The book covers the technological opportunities, benefits and challenges as well as the environmental, economic, and legal impacts.

For the above two publications, contact: IWA Publishing, Alliance House, 12 Caxton Street, London, SW1H 0QS, UK. Tel: +44-207-654-5500; Fax: +44-207-654-5555; E-mail: publications@iwap.co.uk

Hazardous Air Pollutants: Case Studies from Asia

The book examines the variety of public health problems, such as cardiovascular disease, respiratory disease, increased mortality, and impaired mental health, which are severely affecting multiple Asian countries as a result of exposure to high concentrations of air pollution in the wake of rapid industrialization. The contributors to this book have direct research experience in health problems caused by air pollution in the countries under discussion. It expands understanding about the effects of air pollution on public health in Asia and lays groundwork for future approaches to research and policy.

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