VATIS UPDATE

# Waste Management

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## Apprise yourself with the latest technological innovations

### Highlights

- Recycling scrap plastic into 3D printing filaments
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- Method for producing electricity from wastewater
- Combined water jet-plasma scrubber
- New bioremediation agent for oil spills
- Power generation process captures $CO_2$

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

ASIAN AND PACIFIC CENTRE FOR TRANSFER OF TECHNOLOGY (APCTT)

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- 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**

This wastewater treatment plant integrates a Siemens Vertical Loop Reactor, TowBro clarifier and a cannibal system to provide high effluent quality, a reduction in power costs and less solids wasting.
*(Credit: Siemens AG, Germany)*

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## Sustainable recycling industries – a new approach

From 2003, the Swiss Federal Laboratories for Materials Science and Technology (Empa) and the Swiss State Secretariat for Economic Affairs (SECO) have been pursuing recovery of raw materials from waste as a business model for developing countries. Since then, sustainable recycling systems for electrical and electronic waste, or e-waste, have been developed successfully in a number of developing countries. A new programme, "Sustainable Recycling Industries", is to be presented at the "ICT for Sustainability" conference (ICT4S) in Zurich. [The programme was launched at the first ICT4S held in Zurich in February 2013].

Non-renewable raw materials such as copper and gold originate mostly in developing countries. The availability of many metals such as, for example, rare earth elements is becoming noticeably scarcer. Therefore, efficient management of these raw materials is now more critical than ever before. Recycling of discarded consumer goods can make a big contribution; much of this recycling involves electronic devices and household equipment.

In developing countries, the recovery of raw materials is carried out mainly by thousands of uncontrolled workers in the "informal sector". This involves numerous risks, such as environmental pollution, health hazards and cross-contamination of hazardous substances. In general, there is a lack of quality and sustainability standards. A study recently carried out in New Delhi, india, showed that the recycling of plastics is an important economic activity, which in that city alone employs between 20,000 and 25,000 people in more than 7,000 small business units. The analysis also showed that the lead content in recycled plastics, which can be used, for example, to produce children's toys and crockery, is sometimes significantly above the prescribed European limit. Consequently, as part of the new collaboration between SECO and Empa, "Sustainable Recycling Industries" is being launched as an international programme to develop new quality and sustainability standards for secondary raw materials. The new programme is focused on three main areas:

- Improvement of basic data for assessing the quality of secondary raw materials (Empa and the "Ecoinvent" centre are developing regional centres for the collection of data in India, South Africa, Egypt and Brazil);
- Support for pilot projects for improving recycling chains (mainly in Ghana, South Africa, Egypt, Peru, Columbia and India); and
- Introduction of sustainability criteria for non-renewable secondary raw materials (a multi-stakeholder platform will be formed in order to develop sustainability guidelines for non-renewable secondary raw materials).

*www.empa.ch*

## UNIDO to fund Indian projects on biomedical waste treatment

The United Nations Industrial Organization (UNIDO) has launched a project, "Environmentally sound management of medical waste" to reduce Persistent Organic Pollutants (POPs) from biomedical waste in five Indian states. According to UNIDO and the Ministry of Environment and Forest (MoEF), poisonous gases like dioxin and furane are still being emitted from biomedical waste treatment plants, and black ash was found in all the incinerators surveyed by the teams. Experts said that segregation of the waste is not being done properly and till date, many hospital staff are not aware of the colours of the bins in which the waste is to be dumped as per the rules. The states in the project are Punjab, Gujarat, Karnataka, Maharashtra and Odisha.

According to Ms. Erlinda Galvan, UNIDO Industrial Development Officer, the total cost of the project is estimated to be US$40 million for a period of five years, out of which global environmental facility (GEF) is financing US$10 million and co-financing will raise the rest. MoEF is the co-ordinating agency.

*Source: www.indianexpress.com*

## China takes market approach to curb pollution

In China, the Environmental Protection Ministry has issued a guideline, making it mandatory for enterprises with high environmental risk to join an environmental liability insurance system. The Ministry, along with the China Insurance Regulatory Commission, had introduced the insurance system in 2007 in an attempt to use a market-oriented approach to tackle pollution damage and to compensate victims for their losses. The new guideline is to make petrochemical and heavy metal industries join the system, which until now was voluntary. The system has been applied already in more than 10 provinces and regions, insuring more than 2,000 enterprises for almost 20 billion yuan (US$3.17 billion).

According to the guideline, enterprises that are included in the targeted industries but do not join the insurance system will encounter restrictions and difficulty in the approval

of their projects' environmental impact assessments before and after construction, application of environmental protection-related funds and their credit ratings in the banking system. "The environment is under great pressure caused by the rapid development of chemical industries," said Ms. Li Lei, Deputy Director of the Ministry's Pollution Prevention and Control Department. "Chemicals, hazardous waste and heavy metals will be the three main targets in pollution control," she said.

Out of a total of more than 3,000, 58 types of hazardous chemicals are labelled as key for prevention and control in the Management of Chemicals' Environmental Risks under the Five-Year Plan (2011-2015). By 2015, a basic management system will be formed to control the environmental risk posed by hazardous chemicals. Some of the toxic and hazardous chemicals produced or being used in China have already been prohibited or restricted in developed countries, the Plan says.

*Source: usa.chinadaily.com.cn*

## Pakistan moves to ban plastic bags

From 1 April 2013, the use, sale and purchase of polythene plastic bags will be totally banned in the Islamabad Capital Territory (ICT) of Pakistan. The country's Ministry of Law and Justice has notified the Prohibition of Non-degradable Plastic Bags (Manufacture, Sale, Use) Regulation 2013. Regular plastic bags will be phased out in the federal capital over a couple of months, the Climate Change Minister Mr. Rana Muhammad Farooq Saeed Khan stated. At the same time, environment-friendly "Oxo-biodegradable bags" will be introduced, he said while addressing a press conference. The Pakistan Environmental Protection Agency (Pak-EPA) has drafted the text of the plastic bag ban regulation.

Oxo-biodegradable bags – which have a small quantity of olefin mixed with the polyethylene resins – will take only three to four months to naturally decompose, said Mr. Asif Shuja, Pak-EPA's Director General. These bags are already being produced voluntarily by some industry units and some Pakistani companies are also using them in their product packaging, he said. The production of the bags does not require a major change of machinery or process, he added. At present, the regular plastic bags are sold for PRs 85-87/kg (US$0.80), while the Oxo-biodegradable bags cost about PRs 92/kg (US$0.87).

While the ban will start from Islamabad, Pak-EPA is trying to get it approved at the provincial level as well. The Climate Change Ministry has also approached the representatives of the Plastic Bag Manufacturers Association of Pakistan and office bearers of the Karachi and Lahore Chambers of Commerce to draw their support for a national ban on regular plastic bags. To raise awareness about the ban, Pak-EPA will launch a "Say No to Plastic Bags" campaign over the next two months in Islamabad. The campaign will include telling shop keepers to place orders for biodegradable plastic bags instead of polythene bags.

*Source: tribune.com.pk*

## Indonesia encourages textile industry to go green

Indonesia's Ministry of Environment (MoE) has been encouraging the textile industry to become environment-friendly since 2000, said Mr. Arif Wibowo, Deputy Head of environment-friendly technology standardization in MoE, on the sidelines of a workshop on Textile Industry and Eco-labelling in Surakarta. Being environment-friendly would mean water and energy savings by the textile industry, besides recycling the waste generated and reducing the greenhouse effect, he said.

Speaking on the occasion, Mr. Liliek Setiawan, Head of Indonesian Textile Association (API)-Central Java, said that the high cost of investment is a major hurdle in implementing environment-friendly technologies in the textile industry, in the midst of dwindling profit margins. The Indonesian textile industry is growing at high rate and it should consider using green technologies, said Mr. Setiawan. The transition to environment-friendly production processes is not easy, and therefore the government needs to provide incentives to companies that adopt such processes.

*Source: www.fibre2fashion.com*

## Bangladesh goes for power from municipal waste

For the first time, a project on generating electricity from solid municipal waste has been undertaken in Bangladesh, under foreign direct investment (FDI). The Local Government Division under the Ministry of Local Government, Rural Development and Cooperatives signed a contract with an Italian company recently, earmarking an investment component of US$300 million. The project is targeted to produce 100 MW of electricity and organic fertilizer in two phases. The project sites are Aminbazar and Matuail, under the Dhaka City Corporations (DCC) of North Dhaka and South Dhaka, respectively. Dhaka city reportedly produces nearly 5,000 tonnes of waste every day. In the absence of proper management, this has be-

come a major threat to the environment and public health and is also recognised as a potential source of many diseases for decades.

The government initiated the move for the waste-to-energy project in September 2009. However, it was not until December 2011 that the approval to implement the projects was finalized. In order to implement the projects, the DCC (South) and DCC (North) will reportedly lease out a total of 43.4 acres of land to the contracted company. In return, the company is to pay Tk 6.94 million (US$88,600) annually to both the city corporations. The value of the leased land will increase at the rate of 20 per cent every five years. Both DCCs are to supply 4,000 tonnes of solid waste every day for generating power. The government will purchase power from the company at US$0.125/kW (Tk 9.75). The project, on its completion, will create by a rough reckoning, jobs for 2,000 people. The contract has a provision for not raising the rate of power for the next 20 years.

*Source: www.thefinancialexpress-bd.com*

## Viet Nam considers power from garbage

A report by Viet Nam's Ministry of Natural Resources and the Environment (MONRE) showed that the country generates 17 million tonnes of waste every year, including the 6.5 million tonnes from urban areas. Hanoi discharges 5,000 tonnes of solid waste every day, with an estimated annual growth of 15 per cent. HCM City generates 7,500 tonnes of waste a day, the treatment of which costs D235 billion (US$11.12 million) a year. At present, 98 per cent of the waste have been dumped, a rudimentary method that causes a large waste dumps and resultant pollution of the earth and water.

According to Mr. Nguyen Thanh Lam from MONRE, only 15 per cent of the total 23,000 tonnes of household garbage discharged every day in Viet Nam is recycled, composting it into fertilizer. Therefore, using garbage to generate power is an option. According to Mr. Masanori Tsakahara from Hitachi Sozen, a Japanese company, if a garbage treatment factory runs 8,000 hours a year and the electricity generated is sold at US$0.05-0.2 per kWh on average, the garbage treatment cost would be about US$40/tonne. While this is not easily affordable for Viet Nam in view of its current financial resources, the implementation of such a programme is inevitable.

Besides the first-line benefit of addressing the mounting garbage problem, Viet Nam also needs more and more power for its industrialization and transport development. A report says that the total demand for commercial energy in Viet Nam will increase by 7 per cent per year from 2010 to 2025. In Viet Nam, scientists have estimated that the burning of 9,200 tonnes of garbage out of the total 23,000 tonnes generated every day (40 per cent) would produce 200 MW of electricity. The scientists have suggested applying the private-public partnership (PPP) model for financing waste to energy plants.

*Source: english.vietnamnet.vn*

## Rare earth metal extraction programme in Japan

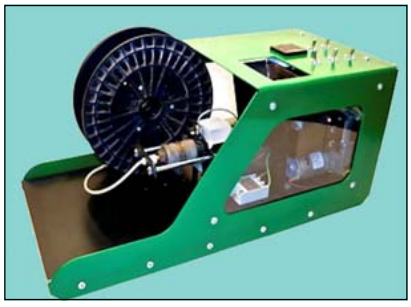
Extraction of rare metals from the earth involves mining and the environmental impact the process entails. But reusing them can help curb demand by companies that need them. Japanese automaker Honda is spearheading a process to reuse rare earth metals extracted from nickel-metal hydride (NiMH) batteries for new ones in a bid to preserve precious and finite resources. The initiative has been put in place at the plant of Japan Metals & Chemicals (JMC), where Honda has been extracting an oxide containing rare earth metals from used NiMH batteries. Honda has succeeded in extracting metallized rare earth that can be used directly as negative-electrode materials for batteries.

*Used NiMH batteries are a useful source of rare earth metals*

The good news is that the rare earth metals extracted in this process have a purity of more than 99 per cent, which is as high as that of ordinary traded, newly mined rare earth metals. In addition, the new process enables the extraction of as much as above 80 per cent of rare earth metals contained in NiMH battery. Starting early March, the extracted rare earth metals are being supplied from JMC to a battery manufacturer, which will reuse them as negative-electrode materials for NiMH batteries for hybrid vehicles. As soon as a sufficient volume is secured, Honda will begin applying the same process and recycle rare earth metals extracted from used NiMH batteries collected by Honda dealers through battery replacement. Honda said it will try extracting rare earth metals not only from batteries but also from various used parts to increase the volume of material being recycled.

*Source: www.justmeans.com*

## Recycling scrap plastic into 3D printing filaments



*The Filabot makes 3D printing filament from scrap plastic*

Desktop 3D printers have hit price-points that make them as affordable as colour laser printers. But they also share the same problem – replacing the printing medium is expensive. One kilogram of plastic filament costs about US$50. But now the Filabot, a miniature plastic recycling plant, will provide a wide variety of plastic filaments from scrap, bringing down the usage cost of 3D printers. The Filabot, invented by Mr. Tyler McNaney, can make new 3D printing filament in 3.0 or 1.75 mm diameters using nearly any household plastic, from polyethylene terephthalate (PET) and polypropylene to Nylon-101. A two-litre PET soda bottle weighs about 50 g, which will be converted into about US$2.50 of 3D printing filament. The Filabot can also recycle broken or obsolete 3D printed parts, making prototype development far less costly. Mr. McNaney has even developed an extrudable conducting plastic from scrap.

The Filabot is fitted with a plastic grinder that converts scrap plastic into tiny pieces suitable as feedstock for the filament extruder. The plastic feedstock is gravity-fed on to a feed screw, which moves the plastic towards the extrusion die. On the way, the plastic is heated – not to melt it, but to allow extrusion at a reasonable pressure for a tabletop unit. On being formed, the new filament is air-cooled slightly, then wound onto an empty spool ready for reuse. No additional treatment or finishing is needed.

*Source: www.gizmag.com*

## New type of recycled plastic from marine waste

In March 2013, two companies – Ecover, a Belgium-based maker of non-toxic cleaning products, and Closed Loop Recycling (CLR) of the United Kingdom that recycles high-density polyethylene (HDPE) bottles back into food-grade plastic (rHDPE) for use in new packaging – officially launched a new initiative that will recycle waste plastic collected from the seas around the United Kingdom by fisherfolk for reuse in new packaging. The two companies are conducting trials to develop a new type of plastic using rHDPE, "plantastic" – Ecover's 100 per cent renewable, reusable and recyclable plastic – and the waste marine plastic that is collected as part of the project.

Both CLR and Ecover are supporting the Waste Free Oceans (WFO) initiative, which aims to reduce floating marine debris on Europe's coastlines by engaging Europe's fishing community to bring floating marine debris back to land for recycling and sorting, as well as sending an important anti-litter message to consumers, highlighting the importance of recycling and the value of used plastic as a resource. Similar initiatives have already been launched in Belgium, Spain, Greece, Germany and Austria.

Ecover's involvement in the initiative is part of its "Message in Our Bottle" campaign, which includes a pledge to deliver continual innovation in tackling issues linked to plastic packaging, and will see the company using an entirely new form of fully recyclable plastic in 2014 made from 100 per cent sugarcane and marine plastic.

*Source: sustainablebrands.com*

## New colorant to ease recycling of black plastics

A consortium of companies in the United Kingdom has developed a process to ease recycling of black plastic packaging. The group of companies – Nextek, Sharpak, Faerch Plast and Linpac – has worked in conjunction with the recycling agency WRAP to develop a new colorant that can be detected by near infrared (NIR) technology. In the past it was not possible to separate black plastics from mixed plastics waste streams. The new black colorants can be detected by NIR spectroscopy – picking out black plastic packaging waste and allowing for sorting by polymer type. The colorants work in amorphous and crystalline polyethylene terephthalate (PET), polypropylene, high density polyethylene (HDPE), polystyrene and polyvinyl chloride (PVC) materials. The new technology can work on existing recycling machinery, with only minor software tweaks – against black conveyor belts, the black plastic items can be mistaken for clear items.

*Source: www.pnchina.com*

## Combustor cuts disposal cost of powdery wastes

Disposing of powdery waste, such as coating powder or swarf, is expensive. The Fraunhofer Institute for Factory Operation and Automation (IFF), Germany, has developed a

*This IFF pilot plant recovers energy from fine grained residues*

novel combustor for powdery residues that will enable companies to cut both disposal and heating costs at the same time. "The plant we developed enables us to recover heat from any combustible, powdery industry waste, whether it is coating powders, polymer powders or even wood constituents," says Mr. Marcus Kögler, in charge of the project. "The potential savings are large: 25 per cent of the natural gas usually used for heating and, additionally, 100 per cent of the disposal costs are being saved at a reference facility. A plant with a larger capacity can even produce electricity that can be supplied to the electrical grid," adds Mr. Kögler.

The plant consists of three basic units: a pulverized fuel burner, a boiler and a filter system. Powdery waste is conveyed into the burner pneumatically, where it is agitated systematically, brought into contact with air and burned. Water stores the heat produced and thus heats facilities or kilns. The flue gases produced during combustion are suctioned off and purified in the filter system. The pulverized fuel burner is approximately 50 times smaller than conventional models and thus has only around two per cent of their capacity. This also makes the burner worthwhile for smaller quantities of waste, like those produced in small- or medium-sized business.

A pilot plant is already operating at MBG Metallbeschichtung Gerstungen GmbH. It cuts the natural gas used by one quarter. The company holds a patent on the process for the recovery of heat from powder residues from coating plants, which was granted in conjunction with this project. The researchers from IFF customized the pilot plant specifically for the company's requirements. Each new plant has to be designed for specific requirements, depending on what powder is produced in that plant. In other words, the pulverized fuel burner's combustion system needs to be engineered for the size of the particles, while and the filter system requires to be designed for optimal filtration of each of the flue gases produced.

*Source: www.sciencedaily.com*

## Recycling process for waste tyres

In South Africa, Reclam Group, a leading producer of recycled metal products in Africa, in partnership with rubber compounder Heever Rubber & Tyre (HRT), has developed a new recycled-rubber technology process that could help meet the country's tyre recycling targets in an environment-friendly manner. The process does not create any harmful emissions and the resulting rubber product could be used in the manufacture of new rubber products, says Reclam's Chief Operating Officer Mr. Harry Kassel. The process produces a compound that eliminates the environmentally negative aspect of tyre recycling. Mr. Kassel adds that the resulting product has become something of a 'cradle-to-cradle' process that is 100 per cent environment-friendly. The first commercial plant that is to be launched later this year will be able to recycle 1,000 t/m of tyres, says Mr. Kassel.

South Africa generates about 11 million scrap tyres a year, which end up in landfills or dumps, or are illegally burned for their scrap steel content, creating a growing health and environmental challenge, says the Department of Environmental Affairs. For this reason, government initiated the Recycling and Economic Development Initiative of South Africa (Redisa), which aims to remove waste tyres from the South African environment through subsidising the collection and recycling process by attaching a value to the collection of scrap tyres. A main element of the Redisa plan is that it will specifically and exclusively target micro and small enterprises (MSEs). A network of collection depots and recyclers will be set up and part of the operating costs of the plan will be allocated to train and support associated MSEs.

*Source: www.engineeringnews.co.za*

## High accuracy sorter for plastics recycling

A prototype machine developed by Japanese companies Mitsubishi Electric Corp. and Shimadzu Corp. can separate plastics waste by type at an accuracy rate of more than 99 per cent. The companies said that the machine fixes the current problem of sorting machines being confused by colours. Shredded plastic from recycled objects such as home appliances is placed on a rotating disk. As the platform turns, the pieces undergo infrared analysis to determine their molecular structure. This spots the difference, for example, between polypropylene and polystyrene, and a jet of air then blows the fragment into the appropriate scoop. The developers said the device uses infrared rays of a longer wavelength than the conventional devices, which allows it deal better with plastics coloured black and blue.

*Source: ajw.asahi.com*

## Recycling electronics with dimethyl sulphoxide

Chinese researchers have developed a simple and eco-friendly method to salvage the materials found in waste printed circuits boards (PCBs) using the solvent dimethyl sulphoxide (DMSO). Mr. Ping Zhu and colleagues at Zhejiang Gongshang University, Hangzhou, have come up with a simple separation process that they say could recover valuable materials from waste PCBs while driving down recycling costs and avoiding environmental pollution caused by other methods. "Other methods separate waste PCBs by decomposing the polymer resin, which can generate highly toxic polybrominated dibenzodioxins and dibenzofurans," states Mr. Zhu. "In our process, the polymer resin is swelled not decomposed into the solution and the solvent can be reused, so the process has no secondary pollution and the operation is simple and easy."

First, the team manually removes the electronic components on waste PCBs and cuts the remaining bare boards into fragments of approximately 1-1.5 $cm^2$ or 2-3 $cm^2$. Then, under a nitrogen atmosphere, the fragments are heated with DMSO. The DMSO swells the brominated epoxy resin, which separates the PCB layers. The solution is then filtered and separated, and the used DMSO is regenerated by evaporation under vacuum to leave the separated polymer resin and the circuit board components.

*Source: www.rsc.org*

## Soluble PCBs eases e-waste recycling

Research in the United Kingdom is poised to make turning trash into

*Waste PCBs contain many valuable, recyclable metals*

cash easier and more profitable than ever before. National Physics Laboratory researchers are currently working to develop water-soluble circuit boards that hold the promise of a major leap in e-waste recycling. The printable boards are designed to get dissolved in hot water, leaving behind only their recyclable metal components. Constructed of polymeric layers that have been shown to withstand heat and other pressures of real-life use, the water-soluble circuit boards can be used to build rigid, flexible and even 3-D structures, allowing the electronics industry to pursue designs using less material, making manufacturing more sustainable.

"Electronics that can be easily separated into their component parts after immersion in hot water would be a complete game-changer in e-waste recycling and urban mining," remarked Mr. Paul Watson, CEO of Green Technology Solutions Inc. (GTSO), the United States, which is working to ramp up its e-waste recycling business. Urban mining is key to the plans of many companies like GTSO to compete against major international corporations in providing sustainable waste solutions. *Contact: Mr. Paul Watson, CEO, Green Technology Solutions Inc., 2880 Zanker Road, Suite 203, San Jose, CA 95134, United States of America. Tel: +1 (408) 432 7285; E-mail: info@gtsoresources.com.*

*Source: www.reuters.com*

## Process for metals recovery from PCBs

In China, researchers from Fujian University of Technology, Research Centre for Eco-Environmental Sciences, and Key Laboratory of Solid Waste Treatment and Recycle carried out a research work to develop an efficient and eco-friendly process for metals recovery from waste printed circuits boards (PCBs) by supercritical water (SCW) pre-treatment combined with acid leaching. In the new process, waste PCBs were pretreated by SCW and the separated solid-phase product with concentrated metals was subjected to an acid leaching process for metals recovery. Two methods of SCW pretreatment were studied to determine its effect on the recovery of different metals from waste PCBs: supercritical water oxidation (SCWO) and supercritical water depolymerization (SCWD).

Both SCWO and SCWD methods had significant effect on the recovery of different metals. SCWO pretreatment was highly efficient for enhancing the recovery of copper (Cu) and lead (Pb), and the recovery efficiency increased significantly with increasing pre-treatment temperature. The recovery efficiency of Cu and Pb for SCWO pre-treatment at 420°C was 99.8 per cent and 80 per cent, respectively, whereas most of the tin (Sn) and chromium (Cr) were immobilized in the residue. The recovery of metals was enhanced by SCWD pre-treatment and increased along with pre-treatment temperature. Up to 90 per cent of cadmium, zinc, manganese, Cr and Sn were recovered by SCWD pre-treatment at 440°C. *Contact: Mr. Fu-Rong Xiu, Department of Environment & Equipment Engineering, Fujian University of Technology, Fuzhou 350108, China. Tel: +86 (591) 22863268.*

*Source: www.sciencedirect.com*

## Bacterial wastewater treatment method

In Canada, NewTerra Ltd. is developing a new water filtration technology that could potentially provide better opportunities for producing and utilizing renewable energy to power wastewater treatment systems. Researchers at Queen's University are currently evaluating the water filtration system by looking into ways to use the MicroClear flat sheet membranes by integrating them into existing water treatment systems, so that they can boost the production of biogas generated from wastewater. At present, the technology is being utilized at the Brockville Wastewater Services Facility, where it is involved in the anaerobic digestion process. This is a bacterial process in which bacteria break down the solids captured or produced in the wastewater treatment process. This produces a mix of methane gas and carbon dioxide (biogas), which is environmentally friendly and carbon neutral.

*Source: www.processingmagazine.com*

## Method for producing electricity from wastewater

Many people still do not see is that there is energy within wastewater itself, according to water resources expert Mr. Bruce Logan from Penn State University, the United States. It is estimated that in the United States, wastewater from domestic use, food processing and animal waste alone contains about 17 GW of energy. There is significantly more energy in the wastewater than the energy it takes to treat it, thus making wastewater a major energy resource, Mr. Logan added. Much of this resource is at present wasted, as wastewater is hardly ever treated with the intention of extracting energy from it, and Mr. Logan is currently researching the options for doing this more efficiently.

Mr. Logan believes that energy in wastewater can be extracted efficiently using two types of microbes – exoelectrogens, which produce electric current, and electrotrophs, which consume electrons and produce hydrogen and methane. For his research, Mr. Logan placed exoelectrogens in microbial fuel cells. This experiment involved only the bacteria already present in wastewater. The experiment provided enough energy to supply electricity to a fan. What Mr. Logan's team is trying to do is harness the power of microbes, which, even without any chemical additives, can help reduce the resource crisis if these tests can be scaled up to real-world capacities. When this is achieved, wastewater treatment facilities could be self-sufficient and may even contribute energy to the grid, rather than consume electricity to function.

*Source: www.processingmagazine.com*

## Membrane distillation for removing drug residues

*The new membrane distillation technology at work*

In Sweden, KTH Royal Institute of Technology researchers have developed a new technique to prevent pharmaceutical residues from entering public waterways. The new water treatment technology called membrane distillation separates drug residues from sewage with the help of district heating, says Professor Andrew Martin at KTH Department of Energy Technology who worked on the project with IVL and Scarab Development AB. Prof. Martin says that water vapour passes through a thin, hydrophobic fabric membrane, and through an air gap to condense onto a cold surface. Drug residues collect on one side of the membrane and pure water on the other.

"There is currently no technology capable of doing this cleaning process on a large scale," Prof. Martin says. For the membrane distillation process to work, the water temperature does not need to be very high. Scientists have pointed out that pharmaceutical residues in wastewater have been found to alter fish behaviour and could even affect the growth of algae. Prof. Martin and his colleagues are now awaiting results from the next step in the evolution of the technique. They are testing membrane distillation with drug residue levels that are nearly 10 times higher, and the samples are out for analysis. *Contact: Prof. Andrew Martin, Department of Energy Technology, School of Industrial Engineering and Management, Brinellvägen 68, S-100, 44 Stockholm, Sweden. Tel: +46 (8) 790 74 73; E-mail: andrew.martin@energy.kth.se.*

*Source: www.kth.se*

## Synergistic system for textile effluents remediation

Researchers at the Department of Biotechnology, Shivaji University, India, have developed a synergistic system of plant and bacteria for the efficient treatment of textile effluents. The research team led by Mr. A.N. Kabra studied decolourization of the dye Scarlet RR (SRR) and a dye

mixture under *in vitro* conditions using the plant *Glandularia pulchella* (Sweet) Tronc., the bacterium *Pseudomonas monteilii* ANK and their consortium. Four reactors – soil, bacteria, plant and consortium – were developed that were subjected for treatment of textile effluents and dye mixture.

*G. pulchella* and *P. monteilii* showed decolourization of the dye SRR by 97 per cent and 84 per cent, within 72 h and 96 h, respectively, while their consortium showed 100 per cent decolourization of the dye within 48 h. In the case of dye mixture, *G. pulchella, P. monteilii* and consortium showed a dye removal of 78, 67 and 92 per cent, respectively within 96 h. During decolourization of SRR, *G. pulchella* showed induction in the activities of enzymes lignin peroxidase and DCIP reductase while *P. monteilii* showed induction of laccase, DCIP reductase and tyrosinase, indicating their involvement in the dye metabolism. High Performance Liquid Chromatography (HPLC), Fourier Transform Infra Red Spectroscopy (FTIR) and High Performance Thin Layer Chromatography (HPTLC) confirmed the biotransformation of SRR and dye mixture into different metabolites. Soil, bacteria, plant and consortium reactors performed an ADMI removal of 42 per cent, 46 per cent, 62 per cent and 93 per cent, respectively, in the first decolourization cycle while it showed an average dye removal of 21 per cent, 27 per cent, 59 per cent and 93 per cent in the next three (second, third and fourth) decolourization cycles for the dye mixture within 24 h.

The consortium reactor showed an average dye removal of 95 per cent within 48 h and 60 h for textile effluents A and B, respectively, for three decolourization cycles, while it showed an average total organic carbon (TOC), chemical oxygen demand (COD) and biological oxygen demand (BOD) removal of 74 per cent, 70 per cent and 70 per cent, 66 per cent, 72 per cent and 67 per cent, and 70 per cent, 70 per cent and 66 per cent for three decolourization cycles of the dye mixture (second, third and fourth decolourization cycles), effluent A and effluent B, respectively. Degradation of the textile effluents and dye mixture into different metabolites by the consortium reactor was confirmed using HPLC and FTIR. Phytotoxicity studies revealed the non-toxic nature of the metabolites of degradation of dye mixture, effluents A and B by consortium reactor. The developed consortium reactor system can be therefore used to treat large amounts of textile effluents when implemented as a constructed wetland by proper engineering approach.

*Source: www.ncbi.nlm.nih.gov*

## Material that uses less energy to treat seawater

Scientists at Nanyang Technological University (NTU) in Singapore have developed a material that can cut by up to half the amount of energy used to purify wastewater and reduce costs by 30 per cent. The material, multi-use titanium dioxide, is cheap and abundant, the scientists claim. It has been scientifically proven to speed up a chemical reaction (photocatalysis) that turns wastewater into hydrogen and oxygen using sunlight while still producing clean water. The material, besides desalinating water, can be used also to help recover energy from desalination waste brine, as well as double the life-span of lithium ion batteries. “We are excited because we can store the energy from the sun and can use it day and night. And the same time, you produce clean water,” said Associate Professor Darren Sun, who helped to develop the material. The team of scientists that achieved the breakthrough has set up a company and is planning to commercialize the material.

*Source: www.channelnewsasia.com*

## Combined water jet-plasma scrubber

Perfluorocompounds (PFCs), such as carbon tetrafluoromethane ($CF_4$), have been extensively utilized for plasma etching and chemical vapour deposition gases in semiconductor manufacturing processes. PFCs have significant effects on global warming and have very long atmospheric life-times. Furthermore, the wastewater, which contains fluorine, would cause groundwater pollution. Mr. Young Nam Chun and Mr. Chae Hong Lee from the Department of Environmental Engineering, Chosun University, the Republic of Korea, developed a system that combines plasma with water jet for PFC destruction, and studied the optimum operating conditions for the system for efficient $CF_4$ destruction by enlarging the discharge region and producing a large amount of hydroxyl (–OH) radicals.

$CF_4$ decomposed by the water jet-plasma produces hydrogen fluoride (HF), which dissolves in the water jet. The system developed utilized electrocoagulation and calcium hydroxide [$Ca(OH)_2$], which is very effective for getting rid of HF from wastewater. For the experimental parameters, the water jet flow rate and input power were considered for the water jet-plasma scrubber, the initial pH and current density for the electrocoagulation process, and the reaction pH and $Ca(OH)_2$ injection volume for the $Ca(OH)_2$ process. It was found in the parametric experiment that: the total $CF_4$ decom-

position efficiency was 99.2 per cent; the removal efficiencies of carbon dioxide and HF, which are the by-products in the gas, were 69.4 and 78 per cent, respectively; and the removal efficiency of HF, which is the by-product in the liquid, was 99.3 per cent. *Contact: Mr. Young Nam Chun, BK21 Team for Hydrogen Production, Department of Environmental Engineering, Chosun University, Seosuk-dong, Gwangju 501-759, Republic of Korea. E-mail: ynchun@chosun.ac.kr.*

*Source: onlinelibrary.wiley.com*

## Precipitation of phosphorus in pulp mill wastewater

*Mr. Timo Laukkanen examining biosludge*

Researchers at Aalto University, Finland, have developed a simple method for reducing the amount of phosphorus in the wastewater of a pulp mill – simultaneous precipitation using iron sulphate. The new method eliminates the need for a separate treatment stage, as the precipitation takes place simultaneously with the actual biological wastewater treatment. Iron sulphate is added to the wastewater prior to the biological wastewater treatment process, and the phosphorus dissolved into the water is precipitated with the biomass at the treatment plant. Finally, the phosphorus is removed from the plant with the sludge. The amount of phosphorus in the wastewater was reduced by more than 80 per cent, when the amount of iron fed into the process was 10 mg/L.

Post-treatment precipitation using aluminium produces difficult-to-process sludge. Hence, simultaneous precipitation seems to be a more advantageous option, observed Mr. Timo Laukkanen, Doctor of Science (Technology) at the University. Simultaneous precipitation does not require additional wastewater treatment units and therefore, there is no need for additional energy in the treatment of the water. Another benefit of the method is that iron sulphate is an inexpensive chemical. Combined with the elimination of additional stages of wastewater treatment, this aspect helps save money and energy and reduces the amount of solid waste. *Contact: Mr. Timo Laukkanen, Doctor of Science (Technology), P.O. Box 11000, Aalto, FI-00076, Finland. Tel: +358 (9) 47 001; E-mail: t.laukkanen@aalto.fi.*

*Source: www.aalto.fi*

## New nanocomposites to treat industrial wastewater

Chemical engineers at Babol Noshirvani University of Technology, Islamic Republic of Iran, synthesized a nanocomposite by using pyrrole monomers, aniline and some basic materials, for use in batch purification process. Elimination of colour, odour, anions and cations in only one stage in a very short period of time (about 30 minutes) is among the notable characteristics of the synthesized nanocomposite.

The researchers first synthesized polymeric nanocomposites based on inexpensive materials such as bran ash. They then succeeded in using the synthesized nanocomposites in the purification of industrial wastewater. Because of the very short treatment time needed, the use of this nanocomposite cuts the high cost of wastewater purification, besides offering a higher efficiency. Dr. Mohsen Qorbani, the administrator of the research, said that the synthesized nanocomposite polymers might have other applications because of their anti-corrosive and anti-bacterial properties.

*Source: www.nanotech-now.com*

## Removing harmful contaminants from wastewater

Mr. Srimanta Ray, a PhD graduate from University of Windsor, Canada, developed a method to degrade the toxic phenolic chemical compounds used in a variety of industrial processes. The method, developed under the tutelage of Dr. Jerald Lalman, relies on using ultraviolet (UV) light and titanium dioxide ($TiO_2$) fibres as a catalyst. Dr. Ray said that he was able to develop, on an experimental nanoscale, a photo-catalytic $TiO_2$ fibre capable of removing more than 99 per cent from a synthetic water stream. The technology could be applied in an industrial or municipal setting by lining the interior of wastewater flow chambers with $TiO_2$ fibre. Untreated water would flow in to the chamber, get blasted by UV light, and flow out the other end virtually free of contaminants.

"It is essentially a green process," Dr. Ray said. "You are not adding any chemicals to degrade these compounds." He has won a two-year post-doctoral fellowship worth US $80,000 from the Natural Sciences and Engineering Research Council. Dr. Ray and Dr. Lalman have also secured two patents related to the use of the nano-catalysts in water treatment and for the production of feedstock chemicals.

*Source: www.uwindsor.ca*

## *In situ* aerobic bioremediation

The Dissolved Oxygen *In situ* (DO-IT™) System from Etec LLC, the United States, addresses the critical governing principles that control the success or failure of any *in situ* bioremediation effort. The first principle is mass balance – how much of a contaminant exists in the sub-surface, and how much of this mass can be removed? In aerobic bioremediation, the mass balance is a function of the stoichiometry of the oxidation-reduction reactions that govern the biological utilization of a specific compound. For example, some aerobic biological degradation requires a large amount of dissolved oxygen. Etec's Super-Ox™ systems address this need for large masses of dissolved oxygen. However, many underground storage tank (UST) sites have thousands of pounds of contamination in the sub-surface, and dissolved oxygen alone often cannot provide the necessary mass of electron acceptor. To address this, ETEC uses a nutrient amendment that also provides secondary electron acceptors (nitrate, sulphate) to support facultative degradation of total petroleum hydrocarbon (TPH) constituents.

Hydraulic influence is the second critical principle. In combination with localized injection and extraction wells, Etec's Super-Ox™ equipment can produce artificial groundwater gradients within the plume area to induce circulation of biologically active treatment water through the groundwater and smear-zone soil. Individual "circulation cells" can be created throughout a plume zone by placing injection and extraction wells at specific locations, for: optimized dissolved oxygen transfer; hydraulic plume control; and induced groundwater gradients via groundwater mounding/drawdown.

Dissolution and desorption are also important. Depending upon their specific physical/chemical characteristics, sub-surface contaminants separate into various phases. However, contaminants in the adsorbed phase (bound to the organic soil fraction) usually represent over 70 per cent of the total sub-surface mass. Successful *in situ* bioremediation must address the adsorbed-phase mass in conjunction with the dissolved-phase constituents for achieving site closure. By constantly replacing and recirculating groundwater within the soil matrix, DO-IT process accelerates dissolution of adsorbed constituents via: maximized and continuous smear-zone soil contact; and enhanced delivery of biological products.

A complete bioremediation process must ensure: availability of specific nutrients to support growth of these bacterial species; abundance of electron acceptors (i.e. dissolved oxygen and secondary electron acceptors); and contact with the dissolved and adsorbed contaminants. DO-IT process ensures each of these. *Contact: Etec LLC, 1887 Main Street, Suite 203, Washougal, WA 98671, United States of America. Tel: +1 (971) 222 3580; E-mail: info@etecllc.com.*

*Source: www.etecllc.com*

## New bioremediation agent for oil spills

EcoSolutions, a United States company specializing in cutting-edge water treatment systems, offers a new product that can ease environmental impacts of flooding or other biological disasters, such as oil spills. OilClean can have a significant impact on contaminated water by combining biological and patented technologies to naturally restore oil-polluted ecosystems. The bioremediation technology uses natural micro-organisms to consume and completely degrade oil and its toxic by-products from soil and water. OilClean is chemical-free, eco-safe, non-toxic, and there are no waste by-products – the oil is not only separated, it is eliminated.

OilClean, developed in conjunction with Pro-Act Biotech, the United States, is a non-invasive treatment system for marsh and wetland ecosystems that can be implemented without additional damage to the habitat – no trampling, wiping or excavation is required. Depending on weather and water conditions, positive results can be seen within weeks. OilClean can also be used to decontaminate dangerous sub-surface oil deposits in beaches, and to clean polluted clean-up waste such as oil-soaked booms, rags, fabrics and plastics.

To enhance the ease of use of OilClean, the companies have also developed self-powered devices that distribute, monitor and regulate the flow of oil-eating microbes, nutrients and oxygen in oil-polluted water. As part of the OilClean system, these devices employ smart sensors that continually measure water quality and automatically regulate the flow of additives to maximize remediation and restoration. *Contact: Mr. David Whitney, Chief Executive Officer, EcoSolutions LLC, 315 Plains Road, Westford, VT 05494, United States of America. +1 (802) 878 74 64; E-mail: dave@ecosoldesigns.com; Website: www.ecosoldesigns.com.*

*Source: www.prweb.com*

## Bioremediation and bioaugmentation mixture

In Mexico, Universidad Autónoma de Nuevo León and Universidad Autónoma Metropolitana are patenting

a method for producing a mixture containing nixtamalized (soaked and cooked in an alkaline solution such as lime water) maize flour and a composition based on saprophytic *Bacillus* bacteria for use in bioremediation and bioagumentation. The mixture is used for bioremediation and bioaugmentation to improve the quality of wastewater and solid surfaces contaminated with putrescible materials (materials that rot). This mixture specifically degrades starch, proteins and lipids. It also reduces the odour and the number of faecal coliforms and generally lowers the content of volatile solids.

The mixture includes a thinner and a composition with high bacterial and enzyme content. The latter contains bacteria in vegetative phase, their spores and some of their lytic enzymes attached to an organic substrate. The organic substrate is a biodegradable material, with high content of fibre that does not gelatinize (low starch content) and has a porous structure. The substrate may be made of, but not limited to, bran of cereals (such as wheat), coconut fibre, etc., but preferably containing wheat bran, along with vitamins, minerals and nutrients. Thinner on the other hand, plays a triple role in useful for bioremediation and bioaumentacion mixture, because in addition to serving to get the desired number of bacteria per gram of mixture for commercial use, it serves as flocculant owing to its high starch content, and as starter or nutritional supplement to support the growth of bacteria in nutrient media.

The substrate is steam-sterilized, inoculated with bacteria and fermented in a conventional aerobic process in solid phase, but without some steps such as separation or purification common in this type of process. The composition with high bacterial and enzyme content is mixed with a dispersant or diluent powder, which can be a meal of, preferably, nixtamalized corn flour. During fermentation, bacteria use nutrients from the solid substrate, and secrete growth lytic enzymes, produce spores, and increase in their number. At the end of fermentation, the composition with high bacterial and enzyme content is dried, ground and mixed with the diluent. The components of the diluent serve the bacteria contained in the composition to start their growth at the site of application and initiate the production of enzymes to break down complex proteins present in the putrescible materials at contaminated sites. *Contact: Universidad Autónoma de Nuevo León, Avenida Pedro de Alba S/N, Torre de Rectoría Ciudad Universitaria San Nicolás de los Garza, Nuevo León, 66451 Mexico.*

*Source: patentscope.wipo.int*

## Biofilm-mediated enhanced crude oil degradation

The bioavailability of organic contaminants to the degrading bacteria is a major limitation to efficient bioremediation of sites contaminated with hydrophobic pollutants. Such limitation of bioavailability can be overcome by a steady-state biofilm-based reactor, according to a study by scientists from Indian Institute of Science Education & Research. The aim of the study, led by Mr. Debdeep Dasgupta at the Department of Biological Sciences, was to examine the effect of such multicellular aggregation by naturally existing oil-degrading bacteria on crude oil degradation. Bacteria capable of utilizing crude oil as the sole carbon source were isolated from river, estuary and sea-water samples. Biochemical and 16S rDNA analysis of the best degraders of the three sources determined *Pseudomonas* species to be the best.

Interestingly, one of the isolates was found to be close to *Pseudomonas otitidis* family which is not reported yet as a degrader of crude oil. Biodegradation of crude oil was estimated by gas chromatography, and biofilm formation near oil-water interface was quantified by confocal laser scanning microscopy. Biofilm supported batches of the isolated *Pseudomonas* species were able to degrade crude oil much readily and extensively than the planktonic counterparts. Volumetric and topographic analysis revealed that biofilms formed in presence of crude oil accumulate higher biomass with greater thickness compared with the biofilms produced in presence of glucose as sole carbon source.

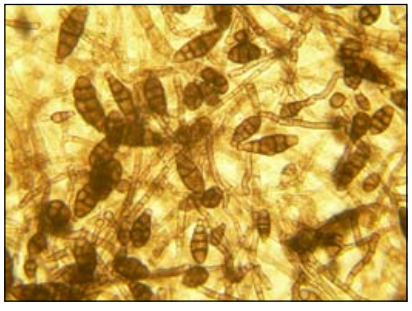
The results of the study consolidate the finding that potent hydrocarbon degrading bacterial consortia exist naturally in the water body near Kolkata port, Haldia Refinery and nearby areas in the eastern regions of India. This signifies that the hydrocarbon degrading bacteria exist or have evolved to exist with the ever-increasing intensity of marine pollution. *Pseudomonas* strains isolated showed that their ability to degrade various complex hydrocarbons and biofilms formed by the isolated bacteria could enhance degradation ability. These strains could be considered therefore for future use for bioremediation of water sources contaminated with oil spill. However, further studies are needed to evaluate the potential of the isolated strains to degrade hydrocarbons *in situ,* in natural environmental conditions. Thus, the oil degradation capability, ability to form biofilm, greater survival in the nutrient stressed condition, cycle of attachment and release of biofilm-associated cells, and cooperative nature of these natural isolates could be exploited

as a better option for bioremediation technology.

*Source: www.hindawi.com*

## Fungi show promise in oil spill clean-up

Bioremediation is regarded as the default method for the rehabilitation of polluted environments because of its cost efficiency and environmental friendliness, but the potential role of fungi in this process is often overlooked. In the Islamic Republic of Iran, scientists have isolated local strains of fungi that can digest petroleum compounds and may be useful in cleaning up polluted sites, especially in similar, semi-arid areas. The researchers isolated fungal strains from sites contaminated with oil within the Arak refinery in Iran and found some of them to cut the amount of petroleum pollution in soil by more than half.



*Magnified view of Alternaria spores*

In the new study, the researchers tested for the first time the four fungal strains found at the Arak site for their ability to grow in polluted soil and to break down petroleum. The research showed that strains from *Alternaria sp.* and *Penicillium sp.* were the most effective at reducing the amount of petroleum in the soil, as the scientists managed to decrease it by around 55 per cent in experiments with sterile soils contaminated with eight per cent crude oil, which is considered a medium level of pollution. "Based on our results, there are several fungi that are resistant to petroleum pollution and they were able to remove oil pollution from the soil," says one of the study's authors, Mr. Abdolkarim Chehregani Rad, an Associate Professor at Bu Ali Sina University.

Mr. Rad says the research team's other work suggest that fungi are more effective than bacteria and plants at getting rid of petroleum pollution. Fungi's resistance to petroleum pollution allows them to grow in contaminated areas; they have a higher biomass so can spread in polluted areas, and they show a high activity of enzymes that break down the oil, according to Mr. Rad. "The fungal growth is visible with the naked eye," he adds, which may help control progress during the application of the fungi in the field.

*Source: www.scidev.net*

## Bioremediation of petroleum refinery sludge

Researchers at University of Buea in Cameroon have carried out an enhanced applied bioremediation project to establish a pilot plan for preparation of a future large scale *ex situ* bioremediation of refinery oily sludge in a tropical soil in West Africa. Prior to this experiment, primary feasibility studies were conducted by developing a consortium of indigenous oil degrading microorganisms, by producing a local oil dispersant named $CNN_{2000}$ (produced by recycling agricultural waste) and establishing that chemical fertilizer NPK 20:10:10 used at 2400 kg/ha will be an appropriate amount to be applied to polluted soil. For the experiment proper, 400 L of waste refinery oil were emulsified with $CNN_{2000}$ and sprayed in a 100 $m^2$ prepared plot, the microbial consortium and fertilizer applied, and the polluted plot watered, tilled frequently and closely observed for six months.

The treatment removed 94 per cent of total petroleum hydrocarbon (TPH) in six months compared with 19 per cent removal of TPH in control plot. Chromatographic analysis revealed that the alkane and aromatic fractions of TPH reduced by 95 per cent and 92 per cent, respectively, while the NSO (nitrogen-, sulphur-, and oxygen-containing compounds) fraction registered an increase. The population of introduced consortium remained stable in the treated plot even after six months. The physical and chemical properties of the treated soil improved during the study period. The practical outcome from this project has revealed that, 40,000 L of waste refinery oil could be treated in 1 hectare plot (10,000 $m^2$) at a cost estimate of approximately US$3.20/$m^2$. This cost could be reduced further during subsequent treatments. *Contact: Mr. George E. Nkeng, Faculty of Science, University of Buea, BP 63 Buea, Cameroon. E-mail: gerardnkwe@yahoo.com.*

*Source: www.omicsonline.org*

**Asian Network for Prevention of Illegal Transboundary Movement of Hazardous Wastes**

This network facilitates the exchange and dissemination of information on transboundary movements of hazardous wastes and selected used equipment among North-east and South-east Asian nations. For details, contact:

*E-mail: env-basel@env.go.jp*
*Website: www.env.go.jp/en/recycle/asian_net*

## Selective catalytic NOx reduction system

Fuel Tech Inc., the United States, has obtained patent on a process and an apparatus that enhance utilization of urea for selective catalytic reduction (SCR) of nitrogen oxides (NOx), by controlled preparation and feed of gasified urea during combustor load variation. The process includes the following steps:

- Determining the concentration of NOx in the combustion gases;
- Determining the total gas flow necessary to supply the SCR reactor with NOx-reducing and carrier gases to be supplied by an injection grid to reduce NOx in the combustion gases to a predetermined level;
- Feeding aqueous urea and gasification gases to a urea gasification unit in quantities sufficient to produce a NOx-reducing gas stream consisting of urea gasification products in amounts sufficient to reduce NOx in the combustion gases;
- Mixing the NOx-reducing gas stream comprising urea gasification products with a stream of carrier gases to provide a grid supply gas stream, and feeding the grid supply gas stream to an injection grid;
- Determining the temperature of the gasification gases fed to the urea gasification unit and the temperature of the stream of carrier gases; and
- Heating the gasification gases fed to the urea gasification unit as necessary to assure that the grid supply gas stream is of a temperature sufficient to reduce NOx in the SCR reactor.

The apparatus includes all the means for achieving the above steps. In one embodiment, a stream of combustion gases is withdrawn from one or more predetermined locations on a combustor operated at a range of loads from low to high, wherein the combustion gases can vary within a range of at least about 93°C, in some cases about 204°C, between low load and high load. In another embodiment, the NOx-reducing gas stream is fed through a hydrolysis catalyst to convert all urea-derived nitrogen species in the gases to ammonia. In another embodiment, the temperature of the combustion gases could be from 204°C to 426°C and could be controlled automatically based on a sensor mechanism.

*Source: www.freepatentsonline.com*

## Venturi scrubbers for dedusting waste gases

Costs and competitive constraints for the company have led to new challenges in process technology. The Venturi scrubber developed by Körting Hannover AG, Germany, for the dedusting of industrial waste gases is an interesting example of how time-tested technologies can still address such new challenges. Körting Venturi scrubbers are designed and manufactured customer-specific for rated flows of 300 to 150,000 m³/h with pressures of 20 up to 150 mbar in all established materials, explains Mr. Arnd Rötz, who heads Körting's Waste Gas Cleaning Department.

Gas cleaning with Venturi scrubbers provides an optimal solution when the boundary conditions of the process, the local situation or the question of the material to be utilized place particular demands. Körting has built an industrial-scale test facility to ensure an on-going further development of this technology. "Variations with regard to ignition, combustion and emission characteristics of the utilized fuels as well as the energy required for the separation process in the Venturi scrubber can be investigated here," Mr. Rötz explains. Burner trials for customers as well as the further development and optimization of burner- and gas cleaning technology can be carried out at the new test facility. *Contact: Körting Hannover AG, Badenstedter Straße 56, 30453 Hannover, Germany. Tel: +49 (511) 21290; Fax: +49 (511) 21 29 223; E-mail: info@koerting.de.*

*Source: www.koerting.de*

## Catalyst for exhaust NOx gas removal

In Japan, Mitsubishi Plastics has announced its full-scale entry into nitrogen oxide (NOx) exhaust gas catalyst manufacturing with its new high-performance zeolite AQSOA used in the Selective Catalytic Reduction (SCR) system. The SCR system is a means of converting NOx contained in exhaust gas into nitrogen and water with the aid of diesel exhaust fluid (DEF) or AdBlue. The market for this technology is expected to expand rapidly for its excellent catalytic performance. Mitsubishi Plastics is developing the business for the unique high-performance zeolite AQSOA, taking advantage of the excellent water vapour adsorbent performance, in adsorption chillers and desiccant air-conditioners that have the potential to use solar heat and low-temperature sources such as factory exhaust heat.

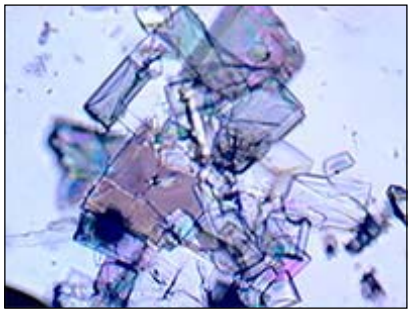
Under the current global trend of increasingly more stringent automotive and truck exhaust regulation, a significant market expansion is expected for the SCR system. And demand for zeolitic catalysts used in the system is also expected to expand rapidly. Mitsubishi Plastics plans to establish a global produc-

tion and supply system of its high-performance zeolite AQSOA for SCR catalysts.

*Source: www.japancorp.net*

## Reusable material for $CO_2$ capture and separation

An international group of chemists from the University of South Florida (USF), the United States, and King Abdullah University of Science and Technology (KAUST), Saudi Arabia, has discovered a more efficient, less expensive and reusable material for carbon dioxide ($CO_2$) capture and separation. The breakthrough could have implications for a new generation of clean-air technologies and offers new tools for confronting the world's challenges in carbon control. The material – identified by the group of scientists as SIFSIX-1-Cu – offers a highly efficient mechanism for capturing $CO_2$. USF chemistry professor Dr. Mike Zaworotko observes that the material also is highly effective at carbon capture even in the presence of water vapour, a standard that other materials have not been able to meet.



*The metal-organic framework material under a microscope*

The new material is a crystal whose atoms form a 3-D lattice with holes that snare molecules of $CO_2$, while allowing other molecules in air to pass. SIFSIX-1-Cu is an adaptation of a material created more than 15 years ago and is named after the chemical component that leads to the special properties; its chemical name is hexafluorosilicate. Porous SIFSIX materials are built from combinations of inorganic and organic chemical building blocks and are part of a general class of materials known as Metal-Organic Materials (MOMs). The group believes the material has three potentially significant applications: carbon-capture for coal-burning energy plants; purification of methane in natural gas wells; and the advancement of clean-coal technology. The next step is to collaborate with engineers to determine how the materials can be manufactured and implemented for real-world uses.

*Source: news.usf.edu*

## Power generation process captures $CO_2$

A "dramatically different" energy generating process developed at Ohio State University, the United States, could keep Ohio Valley residents working in local coal mines for generations to come. A research team led by Professor Liang-Shih Fan is using Coal-Direct Chemical Looping (CDCL) to generate electricity and capture 99 per cent of the carbon dioxide ($CO_2$) that results from the process. The CDCL process is environmentally friendly because the coal is burned in a fully sealed reaction chamber which traps the pollutants.

Prof. Fan explained that the process uses two reaction chambers. In the first chamber, the carbon from coal reacts with oxygen from iron oxide catalysts at high temperatures to form $CO_2$ while iron oxides are converted to iron. "In this step, steam is also produced. Thus, the $CO_2$ and steam rise; the $CO_2$ can be easily separated and captured by cooling the steam to form water," Prof. Fan said. The process leaves behind iron and coal ash. The iron is easily separated from the coal ash based on the size difference, and the coal ash is removed from the entire system. The iron is then delivered to a second chamber, where iron combustion with air produces heat that can be used for electricity generation. The combustion converts iron to iron oxides, which are then used again in the first chamber with fresh, unreacted coal.

Since 99 per cent of the $CO_2$ produced can be captured, Prof. Fan said the gas can be used for multiple purposes, including enhanced oil recovery and chemical synthesis. It also could be "sequestered", or stored underground. But carbon is not the solitary concern when it comes to Ohio Valley coal: much of the coal from the region contains other pollutants such as sulphur. According to Prof. Fan, however, such chemicals are "easily manageable" in the CDCL process. Any sulphur oxides generated from the process can be captured by a traditional flue gas desulphurization unit, he said. The process would produce less nitrogen oxide than traditional, higher-temperature coal combustion, and the compound that is produced would be captured by a traditional selective catalytic reduction unit.

"In terms of pollutant removal, an advantage for chemical looping is that since the flue gas is more concentrated than it would be in a typical power plant flue gas, the equipment needed for removal of sulphur dioxide and nitrogen oxide is smaller," Prof. Fan noted. As noted, only a couple of solid waste products – coal ash and iron oxide – result from the CDCL process. The iron oxide is used to form beads that are reused in the process. And gypsum could come from the flue gas desulphurization unit.

*Source: www.news-register.net*

## Development of a Low-Cost Alternative for Metal Removal from Textile Wastewater

This book focuses on heavy metals found in textile effluents because of their known toxicity effect in the environment. Wastewater from a textile unit in Rwanda has been screened for heavy metals. Batch and pilot experiments on adsorption equilibrium, kinetics, and sulphide precipitation using volcanic rock as adsorbent and packing material have been investigated. A low-cost, integrated system for treatment has been developed, combining an anaerobic bioreactor as the main treatment step, followed by a polishing step that involves a polishing pond containing algae, duckweed and water hyacinth. More than 90 per cent of metal removal was achieved in the bioreactor, with metal sulphide precipitation as long-term removal mechanism. The integrated system for heavy metal removal showed how two complementary systems for heavy metal removal can work in combination and good removal performance can therefore be achieved.

*Contact: CRC Press, United Kingdom. Tel: +44 (1235) 400 524; Fax: +44 (1235) 400 525; E-mail: book.orders@tandf.co.uk.*

## Biomonitoring of Water and Wastewater

Biomonitoring of water quality is very much essential for assessing the overall health of water bodies and safe supply of drinking water. The chemical nature of toxicant is highly dynamic in environment with time and space whereas biological system can integrate all environmental variables over a large period of time in terms of effect that can be easily measured and quantified. In view of the above, it is vital to determine the water quality of natural resources as well as drinking water based on standard protocols and guidelines from regulatory agencies. This book, written by well-known researchers and environmentalists, features topical and emerging issues related to water and wastewater. The diverse topics covered will be suitable for both those already active in the area and for those who are just starting out in environmental science research.

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Hong Kong
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**ECO EXPO ASIA 2013**
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Wanchai, Hong Kong, China.
Tel: +852 1830 668;
Fax: +852 2824 0249;
E-mail: exhibitions@hktdc.org.

**09 Nov**
Bangalore
India

**Indian Congress on Curbing E-Waste**
Contact: Mr. Rajesh Gopinath,
Dept. of Civil Engineering,
Acharya Institute of Technology,
Soldevanahalli, Bangalore 560107,
India.
Tel: +919964739679;
E-mail: rajeshgopinath@acharya.ac.inh.

**13-15 Nov**
Singapore

**WRF 2013 – International Conference on Electronics Recycling Asia**
Contact: Ms. Jeanette Duttlinger,
Congress Organizer, ICM AG.,
Schwaderhof 7, 5708 Birrwil,
Switzerland.
Tel: +41 (62) 785 1000;
Fax: +41 (62) 785 1005;
E-mail: info@icm.ch.

**27-28 Nov**
Malmö
Sweden

**8th Beacon Conference on Waste-to-Energy/ Thermal Treatment**
Contact: Mr. Jakob Sahlén,
Avfall Sverige, Prostgatan 2,
211 25 Malmö, Sweden.
Tel: +46 (40) 356616;
Fax: +46 (40) 356626;
E-mail: jakob.sahlen@avfallsverige.se.

**27-29 Nov**
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**ENVIRO ASIA 2013**
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