VATIS UPDATE

# Waste Management

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## Highlights

- Reclaiming and recycling plastics
- Shape memory helps recycling of gadgets
- Biotechnology breaks down toxic waste
- Green future for scrap iron
- Orange peel to clean up industrial effluents
- Fully sludge-free bioremediation

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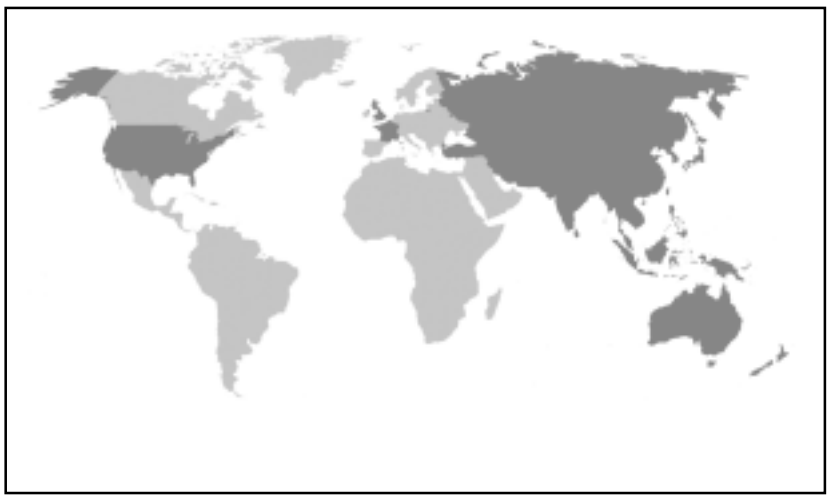
- Advisory services;
- Dissemination of information and good practices;
- Networking and partnership with international organizations and key stakeholders; and
- Training of national personnel, particularly national scientists and policy analysts.



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

**Cover Photo**

A facility for recycling mixed waste streams
*(Credit: Armidale Recycling Centre, Australia)*

**VATIS* Update Waste Management**
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***Website: http://www.techmonitor.net***



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*** Value Added Technology Information Service**

# CONTENTS

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## More chemicals to be tagged as hazardous

Scientists have started reviewing some everyday and industrial chemicals used in such products as carpets and medical equipment to determine whether they should be added to the Stockholm Convention on Persistent Organic Pollutants (POPs), the United Nations-backed treaty banning hazardous chemicals. Twelve chemicals – dubbed the "Dirty Dozen", and including the pesticides aldrin, chlordane, DDT, dieldrin, endrin, hexachlorobenzene, heptachlor, toxaphene and mirex – are already on the Convention's list.

"Chemicals have contributed to human well-being across a range of areas from medicine and foodstuffs to agriculture and industrial processes," said Mr. Achim Steiner, Executive Director of the United Nations Environment Programme, under whose auspices the treaty was negotiated. However, some of these substances now pose real risks to humans and the wider environment, and "Eliminating, restricting and accelerating a switch to better alternatives must be our goal," he added.

Five more substances have already been shortlisted, and the POPs Review Committee will assess four more for possible elimination. Most of these nine chemicals are used in products such as flame retardants in textiles and carpets, and for photo imaging and fire-fighting.

*Source: www.un.org*

## New emission norms in India from 2010

The Government of India has proposed to extend Bharat Stage IV emission norms for four-wheelers to 11 mega cities and Bharat Stage III emission norms throughout the country from April 2010. This is as per the Auto Fuel Policy of Ministry of Petroleum and Natural Gas. The government will enforce Bharat Stage IV emission norms in Delhi/ National Capital Region, Mumbai, Kolkata, Chennai, Bangalore, Hyderabad, Ahmedabad, Surat, Pune, Kanpur and Agra from 1 April 2010. State-run oil companies have undertaken fuel quality upgrade projects for the supply of required upgraded fuel by the target date.

*Source: pib.nic.in*

## More waste disposal sites in Sri Lanka

Sri Lanka has approved two more waste disposal sites, with private sector participation, to handle the garbage generated in the densely populated Western Province that includes the capital, Colombo, said Information Minister Mr. Anura Yapa. The government has approved the use of a 14 acre site in the Enderamulla area, and a 27 acre site in the Ekala area to be used as waste treatment sites. The province is estimated to generate 1,683 tonnes of solid waste a day. About 62 per cent of it is organic waste and 6.5 per cent paper, allowing most of it to be composted, Mr. Yapa said.

*Source: www.lankabusinessonline.com*

## China's appliance giants to take on recycling

Chinese consumers, on average, trash over 5 million TV sets, about 5 million washing machines, and about 4 million refrigerators in a total more than 15 million discards each year.

China's home appliance giants are entering the environmental protection industry, as the government is to issue regulations on the recycling of discarded electronic appliances. The TCL Group recently founded an environment protection investment company jointly with the O'meet Group. Haier and Changhong have already set up recycling centres for discarded electronic appliances, respectively in Shandong and Sichuan.

Overseas environmental barriers are an important reason for TCL's entry into the e-waste management industry. According to the Waste Electrical and Electronic Equipment (WEEE) directives issued by the European Union (EU), home appliance exporters to EU must pay 3-5 per cent of the total price of their exports for the recycling and treatment of electronic waste. However, if the Chinese companies take the discarded appliances back to China, they won't need to pay this fee. At present, China has banned import of discarded home appliances to prevent domestic companies from illegally refurbishing them and reselling them as new ones. The largest discarded product recycling and treating company, O'meet, has been licensed to import discarded home appliances for disassembly.

*Source: www.chinastakes.com*

## Waste to account for 10 per cent of total energy use by 2050

The Republic of Korea will increasingly use waste materials as an energy source, as part of the country's shift towards alternative power sources. The Environment Ministry hopes recycled materials will fuel 10 per cent of the country's total energy needs by the year 2050.

A main part of the plan is to construct energy reclamation facilities next to landfills across the country over the next four years. Officials hope the measure will save W3.2

trillion (US$2.058 billion) in annual energy costs, while lowering around 1,500 tonnes of greenhouse gas emissions per year.

*Source: english.chosun.com*

## Garment waste processing – a key job provider

Recycling of waste materials left by garment factories has emerged as a good income generating source for many people. As the informal sector requires small investment, it attracts a good number of investors who are employing thousands of people in Bangladesh, mostly from the under-privileged classes. The leftovers from garment manufacturing, called *jhoot* by the people involved in the trade, are converted into useful materials. *Jhoot* includes everything from cut-pieces of clothes, buttons, thread, elastic fasteners and empty bobbins to rejected pants, shirts and T-shirts.

"Rags discarded by one are treasure for another. We are helping to relieve the garment industry of a huge burden that was once thrown away in dumpsters," said Mr. Md. Abdur Rashid Sheikh, the Secretary of a garment waste traders' association. Each garment factory announces an auction for waste raw materials every alternate week. The best quality waste cloth sells at Tk 35-40 (US$0.50-0.58) per kg while the price can be as low as Tk 1 (US$0.14) for per kg low quality cloth.

Recycling starts with sorting, usually by the colour, type and condition of fabric. The usable cloths are bought by small garment factories for reproducing clothes with it. The unusable parts and shredded cloths are recycled into waste cotton. Dhaka's mattress industry is dependent on these shredded cloths. Buttons, zippers, elastic fastener, hangers and plastic bags are resold to mini garment accessory sellers.

Around 500 textiles and garments waste processor units are currently under operation in the country and they produce around 500 tonnes of processed waste cotton every day, said sources at Bangladesh Textile and Garments Waste Processors and Exporters Association. Mirpur Section 10 hosts the largest centre, where around 400 stores have employed about 10,000 people, most of them women, for collecting and sorting of the *jhoot* items.

*Source: www.thedailystar.net*

## E-waste disposal in the Philippines

Stroll around the shopping areas in Makati City in Metro Manila, the Philippines, and one will see many green plastic recycling bins into which one may discard old mobile phones, batteries and other small consumer electronics items. This is the first stop of an old gadget's journey to the afterlife.

The bins are owned and emptied by HMR Envirocycle Inc., the only licensed electronic waste (e-waste) recycling facility in the Philippines and one of only two such facilities in Southeast Asia. The Australia-based HMR Group also operates the electronics thrift shops, as part of what may well be a sustainable e-waste recycling business model. It offers, among others, e-waste "demanufacturing" and disposal services, as well as scrap and waste management, crap purchase and asset-value recovery.

HMR also provides data security, meaning, the total destruction of confidential records and assured destruction of discarded and recalled electronic equipment. Asset-tagging inventory and confirmation services are also provided to enable corporate clients to accurately track the lifecycle of each piece of equipment they own so that those items can be disposed of with the least possible environmental impact. The company is reported to manually process approximately 6,995 kg of e-waste a month.

After processing, some wastes, like lead-contaminated glass, are shipped overseas for safe disposal. Materials that can be salvaged locally – such as metals, plastic and glass – are recovered in compliance with stringent local and international environmental standards. The salvaged components are separated, sorted, quality-graded and thereafter sold to manufacturers, as well as other recyclers.

*Source: businessmirror.com.ph*

## Malaysia to fund R&D on fuel from waste plastic

Mr. Fadillah Yusof, Deputy Minister of Science, Technology & Innovation (MOSTI) of Malaysia has said that a Sarawak-based company is carrying out a pilot project to extract fuel from plastic waste. The company has set up a plant in Shah Alam, Selangor to extract fuel from the waste products.

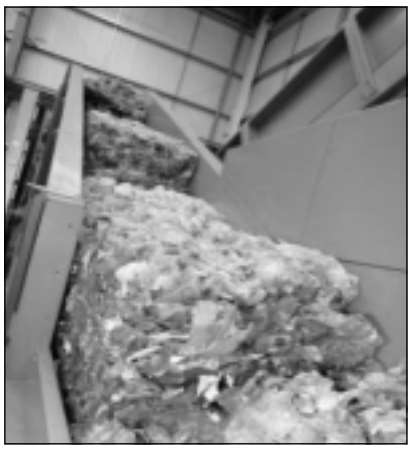
"The Ministry will fund the research and development work, under the MOSTI e-Techno Fund if the pilot project proves successful in a year's time," the Minister declared. The company had submitted an application for M$10 million (US$2.68 million) to MOSTI e-Techno Fund. Mr. Fadillah said the Ministry welcomed the pilot project, as it would help save the environment and address the use of non-biodegradable plastic.

*Source: www.bernama.com.my*

## Plastic bottle recycling system

In the United Kingdom, Closed Loop Recycling Ltd. recycles used plastic bottles back into food-grade quality material in a process chain that involves several technologies in three key stages: sorting, granulating and washing, and decontamination.

The plastic bottles arrive at the plant, squashed and compacted together into square bales, which typically weigh about 500 kg. The bales that contain both PET and HDPE bottles are fed into the bale breaker – six large rotating cork screws that loosen and open up the bale. The crushed bottles then pass through the trommel, which removes small bits of rubbish, such as stones and dirt, as well as any lids and caps that have come off the bottles.



*Bales of plastic bottles arrive at the plant*

Metal contaminants such as food and drink cans, screws and wire are then removed. A powerful electromagnet extracts steel objects and then an eddy current separator is used to remove any aluminium objects. Paper, carrier bags and films are then separated from the bottles by a row of air jets that blow light objects off the conveyor belt. With the majority of unwanted waste removed, the bottles are sorted by type of plastic and colour employing optical sorting machines into: clear PET bottles, light blue PET bottles, HDPE bottles, coloured PET and other plastics. Clear and light blue PET bottles and uncoloured HDPE bottles are granulated into flakes. The flakes are cleaned first by a dry cleaner and then a hot wash (80º C). A sink-float separator is used to separate PET flakes (which sink in water) from HDPE flakes (which float and are skimmed off). Both flakes are then decontaminated.

To return the PET flakes back into a food-grade product, a process developed by United Resource Recovery Corporation of the United States is used. The pure PET flakes are bagged and sold to plastic packaging manufacturers, to be made into new bottles or other food packaging. HDPE flakes are processed into food-grade material employing a Vacurema, which treats the flake under low pressure and high temperature. Heating the flakes to over 200ºC melts them, eliminating any contamination. The molten plastic is extruded, filtered, cut into small pellets and cooled for use in making new milk bottles. *Contact: Closed Loop Recycling Ltd., 16 Choats Road, Dagenham, Essex RM9 6LF, United Kingdom. Tel: +44 (20) 8593 6040; Fax: +44 (20) 8593 6511; E-mail: info@closedlooprecycling.co.uk.*

*Source: www.closedlooprecycling.co.uk*

## Reclaiming and recycling plastics

In the United States, Tyco Healthcare Group LP, together with Mr. Piyush Reshamwala and Mr. John Japuntich, has patented a process for reclaiming and recycling plastic from discarded plastic articles. The process includes breaking down waste materials into pieces using mechanical force, removing non-magnetic pieces, separating out relatively heavy pieces from the non-magnetic pieces, segregating relatively non-conductive pieces from the heavier pieces, and reclaiming plastic pieces from the relatively non-conductive pieces.

The system includes a crusher for breaking down the discarded materials, a magnetic separator for the removal of relatively non-magnetic pieces, an air classifier for separating out relatively heavy pieces from the non-magnetic pieces, an electrostatic separator for segregating non-conductive pieces from the relatively heavy pieces, and a metal detector for separating out plastic pieces from non-conductive pieces. The recovered plastic is moulded in an injection moulding machine. *Contact: Tyco Healthcare Group LP, 15 Hampshire Street, Mansfield, MA 02048, United States of America.*

*Source: www.wipo.int*

## Up-cycling of PET to biodegradable plastic PHA

A team of scientists from University College of Dublin and Trinity College, both in Ireland, and Institute for Technical and Macromolecular Chemistry, Germany, has studied the conversion of the polymer polyethylene terephthalate (PET) to a biodegradable plastic polyhydroxyalkanoate (PHA).

PET was pyrolysed at 450ºC resulting in the production of solid, liquid and gaseous fractions. The liquid and gaseous fractions were burnt for energy recovery, while the solid fraction terephthalic acid (TA) was used as the feedstock for bacterial production of PHA. Strains previously reported to grow on TA were unable to accumulate PHA. The bacteria were therefore isolated from soil exposed to PET granules at a PET bottle processing plant. From the 32 strains isolated, three strains

capable of accumulation of medium chain length PHA from TA as a sole source of carbon and energy were selected for further study.

These bacterial isolates were identified using 16S rDNA techniques as *Pseudomonas putida* (GO16), *P. putida* (GO19), and *P. frederiksbergensis* (GO23). Strains GO16 and GO19 accumulate PHA composed predominantly of a 3-hydroxydecanoic acid monomer while the strain GO23 accumulates a PHA with 3-hydroxydecanoic acid as the predominant monomer with increased amounts of 3-hydroxydodecanoic acid, compared with the other two strains. PHA was detected in all three strains when nitrogen depleted below detectable levels in the growth medium.

Strains GO16 and GO19 accumulate PHA at a maximal rate of about 8.4 mg PHA/l/h for 12 h before the rate of PHA accumulation fell dramatically. Strain GO23 accumulates PHA at a lower maximal rate of 4.4 mg PHA/l/h but there was no slow down in the rate of PHA accumulation over time. *Contact: Dr. Kevin O'Connor, School of Biomolecular & Biomedical Sciences, University College Dublin, Belfield, Dublin 4, Republic of Ireland. Tel: +353 (1) 716 1307; Fax: +353 (1) 716 1183; E-mail: kevin.oconnor@ucd.ie.*

*Source: pubs.acs.org*

## Infra-red optic device for waste plastic recycling

IoSys, Germany, developed Mobile Infra-Red optic (mIRo) device for identifying plastics, as plastic recycling demands that plastic materials be sorted according to their type. This plastic distinction technology, which involves Near Infra-Red (NIR) spectroscopic analysis, can easily distinguish the waste plastic at the touch of a screen. Data processing is carried out by the PC unit built into by the system. Its operation is easy, without the need for any special facilities. These features make mIRo suitable for fieldwork. Other key features include:

- Non-destructive measurement;
- Less than 1 sec measuring time;
- Analysis of non-dark-coloured plastic possible;
- Possibility of calibration and editing of up to 8 individual plastics or mixtures by customer; and
- A wide range of polymer types can be identified.

The equipment measures 364 mm (W) × 316 mm (L) × 195 mm (H), and weighs about 8 kg. *Contact: IoSys - Dr. Timur Seidel e.K., Steinhauser Str. 14, D-40882 Ratingen, Germany. Tel: +49 (2102) 895 001; Fax: +49 (2102) 895 002; E-mail: office@iosys-seidel.de.*

*Source: www.iosys-seidel.de*

## Waste plastic film processing equipment

China's Suzhou Yaoshi Machinery Co. offers equipment for crushing, washing and drying waste polypropylene (PP) and polyethylene (PE) film products. Waste agricultural films, packing material and hard plastics can be treated step by step by this machine. This processing line can be linked to a granulating system for reducing waste PE and PP films into granular material to produce new PE/PP films. The PE/PP granules may then be injection-moulded to finished products.

The company supplies all these machinery that integrates into a complete system that includes belt conveyors, film/sheet processing tanks, scrubbing/washing equipment, crushers, screw conveyors, dewatering and drying systems, injection moulders, etc. *Contact: Suzhou Yaoshi Machinery Co., West of Fourth Bridge, Sanxing Town, Zhangjiagang, Jiangsu, 215624 China. Tel: +86 (512) 5853 8148; Fax: +86 (512) 5853 0618; Website: www.ysmachine.com.*

*Source: yaoshi.en.alibaba.com*

## Recycling mixed plastics

Plastinum Polymer Technologies, the United States, has developed a process to recycle more types of plastic than just milk jugs and soda bottles. Formerly non-recyclable household plastics, scrap automobile and electronic plastics, and post-production waste plastics can now be made into new items to be used in various different settings. The proprietary process, called Blendymer Technology, allows mixed plastics to be processed without sorting to create new high-quality plastic.

The recycled plastics created by the Blendymer process are Infinymer SSL and Infinymer SML. Infinymer SSL is like polyolefin and Infinymer SML is like polystyrene. *Contact: Plastinum Polymer Technologies Corp., 10100 Santa Monica Boulevard, Suite 300, Los Angeles, CA 90067, United States of America. Tel: +1 (310) 651 9972; Fax: +1 (310) 861 1502.*

*Source: tech.blorge.com*

**Indo European e-Waste Initiative**

The Indo-European e-Waste Initiative (IEeWASTE) website provides an information base, a legislative framework, stakeholders' opinions and models for holistic management of e-waste in India, as well best practices in developing and developed countries.

For further information, access:

*http://www.ieewaste.org*

## Recycling of PlayStation consoles

The Electronic Waste Company in the United Kingdom has announced that it is to carry out the first stage of recycling one of the world's most pioneering and popular computer games consoles – the Sony PlayStation. It has signed contracts with Sony Computer Entertainment Europe to shred and dispose of the plastic cases of the consoles – an estimated 250 tonnes or 300,000 cases in the first year alone – for Sony operations in Europe.

Routes for the recycled plastic have already been already identified as pens, chairs, etc. The Electronic Waste Company has significantly invested in new machinery, which can process a range of plastics and generate high-quality materials ready for the manufacture of new products. The machinery can process plastics ranging from thin films to the thickest of polyurethanes. The company will ensure 100 per cent reuse or recycle of this equipment; nothing collected or brought to the company will be sent to landfill. It is now developing processes to remove other recyclable components – such as clips and foam – from the PlayStation casings.

*Source: www.mcvuk.com*

## A commercial recycling process for electronics waste

Plastic Herverwerking Brabant BV (PHB), a Dutch plastic recycling firm, has become the first supplier in the world of a complete commercial altered-density-media system for separating the plastics in waste electrical and electronic equipment (WEEE). PHB is operating a WEEE recycling system with a capacity of 15 million kg/year, averaging about

*PHB installation for PS-ABS separation*

1,195 kg/h of reclaimed material from 4,990 kg/h of waste input. The relatively small proportion of recaptured saleable material pays off because it includes about 10 per cent valuable metals – mostly copper, but also gold. PHB builds commercial recycling machinery through another company called Envirotec BV.

The Envirotec line starts with shredded WEEE plastic with more than half contamination from non-ferrous metals, stones, polyurethane foam, glass, etc. The waste is fed into a box where a high-torque rotor with paddles turns at 3,000 rpm to beat the flakes against a screen cage, removing most of the surface dirt, sand, rocks and foam in seconds.

Flakes then go onto a large inclined tray with a grooved surface. Water sluices over the left half of the board, washing the plastic flakes down. Heavier metals stay in the grooves and move off to the right. The plastic flakes are then ground into 10 mm particles in a granulator, and sent to the first float/sink tank, which is filled with plain water. Polyethylene (PE) and polypropylene (PP) float off and are collected. Acrylonitrile butadiene styrene (ABS), polystyrene (PS) and flame-retardant (FR) materials sink, and are moved into another tank containing an aqueous solution of 1.035 g/cc density as well as three rotating drums with paddle vanes. PS floats in this tank and is collected, while ABS and FR materials sink. ABS and FR go into a third tank fitted with four drums having paddle vanes and filled with a water solution of 1.07 density. Here ABS floats and is collected, while FR materials sink.

This WEEE recycling process is suitable for appliances that are free from grease and grime and do not require pre-wash. The closed-loop system does not change the water column, but continuously filters out particulates with a fine Nylon mesh on a revolving belt, which is cleaned at one end by high-pressure water jets. *Contact: Envirotec B.V., Duikerweg 32, 5145 NV Waalwijk, The Netherlands. Tel: +31 (416) 697 445; Fax: +31 (416) 697 311; E-mail: info@envirotec-rec.com.*

*Source: www.allbusiness.com*

## Extraction of chemicals from lithium batteries

In Brazil, LG Electronics de São Paulo Ltda. and Mr. Marcelo Bozzo have jointly patented a process for extracting the chemical compounds found in secondary lithium-ion batteries. The process uses relatively low temperatures and a low-toxicity solvent that is easy to be obtained and handled. The process consists of six main stages: (1) opening and separation; (2) extraction of lithium compounds through an organic solution; (3) positive electrode dissolution; (4) aluminium separation; (5) cobalt compounds precipitation; and (6) copper collector separation (negative electrode).

The process begins with cutting open the battery: the polymeric body, the metal body, the terminals and the side nickel tape are separated at this stage and sent to companies specialized in recycling such components. Both the electrodes and separators undergo a process for the extraction of lithium (Li) components. They are placed in a solution

*One type of lithium ion battery*

of hydrated alcohol and acetone (5 per cent). They remain immersed for about two hours, during which time Li salt extraction occurs. Then the electrodes are removed and the solution filtered, separating lithium carbonate and lithium hydroxide, which resulted from the initial reaction, from the organic solution. The filtrate holds the alcohol/acetone solution and residues of solvent and battery electrolyte.

After Li compounds are extracted, the positive electrodes are immersed in acid aqueous solution for the dissolution of aluminium and cobalt and lithium oxide. The solution is filtered: aluminium and cobalt remain in the filtrate. Ammonium hydroxide (30 per cent) is used for precipitating aluminium in the filtrate. For the cobalt compound precipitation, a saturated lithium hydroxide solution is added, making the solution basic. After the precipitation, the precipitate is filtered and dried. A hydrochloric acid solution (5 per cent) is added to the negative electrodes to remove agglutinant and graffiti. After ten minutes of stirring, the solution is filtered. The graffiti and the agglutinant are released, passing through the holes, while the copper remains in the perforated container. The agglutinant and graffiti are filtered out, and the acid solution can be reused in the process for a couple of times. *Contact: LG Electronics de São Paulo Ltda., Avenida Dom Pedro I, W 7777, Prédio 1 e 2- Área Industrial- Taubaté, São Paulo - CEP 12090-000, Brazil.*

*Source: www.wipo.int*

## Rotary thermal oxidizer for battery recycling

International Metals Reclamation Company Inc., the United States, has patented a rotary thermal oxidizer that removes polymeric and other non-metal components of exhausted batteries and cells leaving valuable metals – such as nickel, cadmium and iron – behind for subsequent processing.

Pre-heating the sweep gas to a temperature above the auto-ignition point of the polymers, prior to their introduction into the oxidizer, and controlling the oxygen content within the oxidizer, substantially reduces the risks of explosion and fire associated with the pyro-metallurgical recycling of the cells. The thermal oxidizer thus includes provision to pre-heat the sweep gas entering the oxidizer to adequately heat the cells and initiate polymer combustion under controlled conditions. A water spray protects the oxidizer by controlling its internal temperature. It also controls the combustion of the entrained polymeric components, thereby avoiding the possibility of explosions. An explosion plate is included in the discharge housing as a safety device.

*Source: www.freepatentsonline.com*

## Shape memory helps recycling of gadgets

Recycling devices built with plastic cases and other components – such as mobile phones, mp3 players and personal digital assistants – is difficult and needs repetitive manual labour. However, a new approach to creating the fastenings and tabs for such devices based on the shape-memory effect in plastics may allow the process to be automated. The approach – proposed by Mr. Habib Hussein and Mr. David Harrison of the School of Engineering and Design at Brunel University, the United Kingdom – would allow valuable components and metals to be recovered more efficiently from the millions of devices discarded every year.

The researchers studied the possibility of 'Active Disassembly using Smart Materials', which employs materials that can act as fasteners within a product and, at product's end of life, can be undone simply by direct heating. This releases the fasteners, causing the device case to fall apart without manual intervention. This is an important design feature that might make recycling electronic devices with plastic cases much easier. According to the concept of shape memory effect, materials such as engineering plastics (polymers) can be fabricated in one shape – the unfastened state – and then moulded a second time into a new shape – the fastened state. When the plastic in fastened state is heated, it will revert to its original unfastened state, because it retains a molecular memory of its original form.

The researchers have developed a case-fastening device based on one such shape memory polymer. Their tests demonstrated that lowering the device at end of life into hot water, leads to the fasteners reverting to their unfastened state and the case falling apart on agitation. They have also shown that the fasteners retain their integrity for at least two years without falling apart spontaneously.

*Source: www.sciencedaily.com*

## Treatment of PCB-contaminated soil

In recent years, problems related to soil contaminated with polychlorinated biphenyls (PCB) have been increasing. Toshiba Corporation of Japan has developed a technology, called "geosteam technology", for the remediation of PCB-contaminated soil. This technology achieves the dependable destruction of PCBs by a chemical reaction using steam.

After a step-by-step verification of this technology through tests, Term Corporation, in co-operation with Toshiba and Konoike Construction Co. Ltd., has constructed Japan's first commercial plant for remediation of PCB-contaminated soil in Kitakyushu City. *Contact: Technology Planning Division, Toshiba Corporation, 1-1, Shibaura 1-chome, Minato-ku, Tokyo 105-8001, Japan. E-mail: review@toshiba.co.jp.*

*Source: www.toshiba.co.jp*

## Remediation of PAH-contaminated soil

Researchers from Queen's University, Canada, have assessed the feasibility of a two-step treatment process for the remediation of soil contaminated with a model mixture of polycyclic aromatic hydrocarbons (PAHs): phenanthrene, pyrene and fluoranthene.

The initial step of the process involved contacting contaminated soil with thermoplastic polymeric pellets (polyurethane). The ability of three different mobilizing agents – water, Biosolve surfactant and isopropyl alcohol – to enhance recovery of PAHs from soil was investigated, and the results were compared with the recovery of PAHs from dry soil. The presence of isopropyl alcohol had the greatest effect on PAH recovery, with absorption of about 80 per cent of the original mass of PAHs in the soil by the polymer pellets in 48 hours.

The second stage of the treatment involved regeneration of the PAH-loaded polymers via PAH biodegradation, which was carried out in a solid/liquid two-phase partitioning bioreactor. In addition to the PAH-containing polymer pellets, the bioreactor also contained a microbial consortium that was pre-selected for its ability to degrade the model PAHs. After 14 days, 78, 62 and 36 per cent of phenanthrene, pyrene and fluoranthene, respectively, had been desorbed from the polymer and degraded. The rate of phenanthrene degradation was limited by mass transfer of phenanthrene from the polymer pellets. A combination of mass transfer and biodegradation rate might have been limiting for pyrene and fluoranthene.

*Source: www.clu-in.org*

## Biotechnology breaks down toxic waste

Australian scientists have developed a new technology that can easily break down recalcitrant chlorinated hydrocarbons (CHC) on site. "Our technology is based on the use of granulated activated carbon which, together with a common solvent and an electron enhancer, helps hydrogen turn a CHC into a hydrocarbon and salt, thereby converting a harmful compound into harmless ones", said Dr. David Garman, Executive Director of Environmental Biotechnology CRC (EBCRC).

The novel process, developed by EBCRC researchers, mimics a biological process by using molecules to assist with reactions that would not occur under normal conditions. It permits the re-use of activated granulated carbon used to remove and breakdown CHCs. A biologically based compound, such as a vitamin, is added to assist inorganic reduction of CHCs.

The process regenerates activated granulated carbon by solubilizing the bound halogenated hydrocarbons to a gas and a liquid that will allow their safe destruction. The activated carbon is then recycled for reuse or disposed of as a low impact waste. *Contact: Environmental Biotechnology CRC, Australian Technology Park, Locomotive Workshop, Suite 3010, Eveleigh, NSW 2015, Australia. Tel: +61 (2) 9209 4970; Fax: +61 (2) 9209 4980; E-mail ebcrc@ebcrc.com.au.*

*Source: www.sciencealert.com.au*

## Process for removing compounds from a vent stream

In the United States, UOP LLC and three inventors – Mr. Leon Yuan, Mr. Steven M. Poklop and Mr. William D. Schleter – have patented a process for removing dioxin and furan from a vent stream of facilities such as a refinery or a petrochemical production facility. The process can include: (a) passing a first stream from a catalyst regeneration zone, comprising halogen and at least a dioxin and a furan, through a halogen removal zone, comprising an adsorbent to adsorb at least one halogen; and (b) combining the first stream from the halogen removal zone with a second stream from a heater from the catalyst regeneration zone, and obtain a combined stream at a temperature of above 150ºC and an oxygen content no less than 1 per cent.

Generally, a refinery or petrochemical production facility includes: (a) a catalyst regeneration zone; (b) a halogen removal zone; and (c) an elimination zone for at least one

dioxin or a furan compound. An effluent from the halogen removal zone can be combined with an air stream from the regeneration zone or halogen removal zone. Thus, the system permits the combination of a vent gas stream that can have insufficient temperature and oxygen to an existing process stream that provides sufficient heat and oxygen, so that the operating conditions are sufficient to catalytically destroy dioxins and furans.

The system permits changing the temperature and oxygen content of the gas stream coming into the elimination zone without the expense for an additional heater. Should the throughput through the heater for the drying zone be reduced due to required regeneration conditions, the invention can improve existing heater operations by increasing the total throughput through the heater. *Contact: UOP LLC, 25 East Algonquin Road, P.O. Box 5017, Des Plaines, Illinois 60017-5017, United States of America.*

*Source: www.wipo.int*

## Thermal desorption of PCBs from contaminated soils

Researchers at METEA Research Centre, Italy, have investigated a combined technology for the remediation of polychlorinated biphenyls (PCBs) in soil employing thermal desorption coupled with catalytic hydrogenation of recovered PCBs.

The reactor employed was a bench-scale rotating desorption furnace through which nitrogen was flushed and used as carrier gas of desorbed PCBs. The desorbed PCBs were condensed into a hexane-acetone (1:1 v/v) or hexane solution, which was then hydrogenated using as catalyst phosphate-supported palladium or rhodium.

Analysis of the treated soil under variable operating conditions of temperature and desorption time showed a nearly total (99.8 per cent) removal of PCBs. The recovery yield of the desorbed PCBs was better than 75 per cent, and the subsequent hydrogenation reached 63 per cent of the collected PCBs in 5 hours or 100 per cent in 12 hours.

*Source: www.clu-in.org*

## Catalytic conversion of polychlorinated benzenes and dioxins

Chlorinated benzene, particularly 1,2-dichlorobenzene (1,2-DCB), has been widely used as one of surrogate compounds of dioxin to find the noble methods to control dioxin. However, the relationship between the catalytic activity of dioxin surrogate compound and dioxin has not been understood well. Mr. Jung Eun Lee and Mr. Jongsoo Jurng from the Centre for Environmental Technology Research, Korea Institute of Science and Technology (KIST), Republic of Korea, used a vanadium based catalyst ($V_2O_5/TiO_2$) to compare catalytic activity of chlorinated benzenes and dibenzo-*p*-dioxins with low-chlorine content using the lab-scale system.

The researchers studied the catalytic conversions of low-chlorinated dioxins, [2-monochlorodibenzo-*p*-dioxin (2-MCDD), 2,3-dichlorodibenzo-*p*-dioxin (2,3-DCDD)] and polychlorinated benzenes [1,2,3,4-tetrachlorobenzene (1,2,3,4-TeCB), pentachlorobenzene (PeCB), 1,2-DCB, hexachlorobenzene (HCB)] using a $V_2O_5/TiO_2$ catalyst to understand quantitative relationship between dioxin and benzene with the chlorination level. The catalytic decomposition of chlorinated aromatic compounds was 1,2-DCB > 1,2,3,4-TeCB > 2-MCDD > PeCB = 2,3-DCDD > HCB. It might be more reasonable that PeCB or HCB be used as the dioxin surrogate compound rather than 1,2-DCB.

The researchers also investigated the effect of both oxygen content and space velocity (SV) on the catalytic decomposition of 1,2-DCB in the presence of the catalyst because these factors should be considered significantly in combustion facilities to control various pollutants. The decomposition of 1,2-DCB shows dependency on SV while the effect of oxygen content on the catalytic decomposition is negligible in the range of 5-20 per cent. *Contact: Mr. Jongsoo Jurng, Centre for Environmental Technology Research, Korea Institute of Science and Technology (KIST), 39-1 Hawolgok, Seongbuk, Seoul 130-791, Republic of Korea.*

*Source: www.springerlink.com*

**POPs Toolkit**

This Toolkit has been created as part of the World Bank Regional Capacity Building Programme for Health Risk Management of Persistent Organic Pollutants (POPs) in South East Asia Project. It provides general information on POPs and guidance on risk assessment process. The Toolkit aims to enhance the capacity of key decision makers to apply the understanding gleaned from the risk assessment activities to set risk management strategies and identify priority interventions. It provides guidance on:

(1) Evaluating health risks from exposure to chemicals in locally relevant sectors based on standardized guidelines; and
(2) Developing strategies for managing human health risks through regulation, monitoring and evaluating alternative scenarios.

For more information, access: *http://www.popstoolkit.com.*

## Green future for scrap iron

Prof. Wei-xian Zhang, a professor of civil and environmental engineering at Tongji University, China, has concluded a five-year research project in which he and his colleagues used about 900,000 kg of scrap iron to detoxify pollutants in industrial wastewater. The project, carried out in Shanghai, was the largest in history to use iron in an environmental application. The iron, called zero-valent iron (ZVI) because it is not oxidized, was obtained as turnings or shavings from local metal processing shops at scrap value.

The ZVI project began with small, bench-top experiments in the laboratory that used a total of 40 kg of iron to treat toxins in solution. It graduated into a pilot test using a copper-activated iron to pre-treat wastewater in small pharmaceutical, chemical and materials companies. The wastewater had previously been treated with micro-organisms alone. ZVI augmented and improved this remediation method.

Following the pilot test, a full-scale treatment reactor, capable of processing about 60 million litres per day of wastewater, was constructed ad connected to the biological treatment plant. The addition of ZVI treatment to the traditional biological methods of wastewater treatment resulted in notable improvement in reducing pollutant levels, according to Prof. Luming Ma, who directs the National Engineering Research Centre for Urban Pollution Control in Tongji's College of Environmental Science and Engineering. The biological oxygen demand (BOD) removal rose from 76 to 87 per cent. Improvements were also recorded with the removals of nitrogen (13 to 85 per cent), phosphorus (44 to 64 per cent), and colours and dyes (52 to 80 per cent).

Toxic compounds in industrial wastewater, many of which are synthetic organic chemicals, are attracted to the surface of the iron, where they share electrons with the iron and are degraded and detoxified. The ZVI, which gets oxidized during this exchange, has a useful lifetime of about two years in the treatment process. The ZVI is chemically similar to iron-based nanoparticles invented by Prof. Zhang that are now widely used in North America to clean decontaminated soil and groundwater.

*Source: www.sciencedaily.com*

## Biological water treatment

Basin Water Inc., the United States, recently unveiled its newly acquired Envirogen environmental treatment products. In the area of water treatment, Envirogen products include fluidized-bed bioreactors, membrane bioreactors and suspended carrier reactor systems.

*Basin Water perchlorate and nitrate removal systems*

Envirogen bioreactor systems are designed to handle a broad range of contaminants, flow rates and contaminant concentrations. At the high-flow end of the spectrum, Envirogen fluidized-bed bioreactors feature a fixed-film reactor column that fosters the growth of micro-organisms on a hydraulically fluidized bed of media. The fluidized media can provide a biomass inventory of up to 15,000 mg/l, allowing the treatment of high flow rates and relatively high contaminant loadings. Primary applications for this technology include nitrate removal from wastewater.

Envirogen membrane bioreactors combine the benefits of a suspended growth reactor with the solids separation capability of an ultra- or micro-filter membrane unit. The systems are particularly well-suited to wastewater or groundwater streams with difficult-to-treat organics, high contaminant concentrations, highly variable influent compositions or for sites where system footprint is a concern. Envirogen membrane bioreactor applications today include batch chemical plant effluents, landfill leachate, chlorinated solvents in manufacturing wastewaters, etc.

Envirogen suspended carrier reactor systems are integrated, fixed-film moving bed activated sludge biological systems for the treatment of municipal and industrial wastewaters. These systems are suitable for retrofit applications in activated sludge biotreatment installations that are operating at or exceeding design capacity. *Contact: Basin Water Inc., 9302 Pittsburgh Avenue, Suite 210, Rancho Cucamonga, CA 91730, United States of America. Tel: +1 (909) 481 6800; Fax: +1 (909) 481 6801; E-mail: info @basinwater.com; Website: www.basinwater.com.*

*Source: www.marketwatch.com*

## Method to produce amides with 'no wastewater'

A Japanese research team has developed a hydrolysis process based on a new complex catalytic method and succeeded in eliminating wastewater during amides production. The team was led by Dr. Toshiyuki Oshiki of the Okayama University Graduate School of Natural Science and Technology.

Amides production by copper catalyst and enzymatic methods require large amounts of water, and consequently produce a large amount of wastewater. For example, hydrolysing acrylonitrile using any of the two methods produce an acrylamide. However, this production process uses water in the molar ratio of 100 water to 1 acrylonitrile. As a result, a large amount of industrial wastewater is produced. Furthermore, thermal energy is lost during the water condensation process, and the transportation efficiency is low because acrylamide is produced as a 50 per cent water solution.

The new catalytic method, in contrast, called "dual-function complex catalysis", uses a ruthenium or iridium complex. Water is activated under neutral conditions and nitrile is activated mainly by metal. Hence, the reaction progresses without a solvent under neutral conditions. The hydrolytic reaction proceeds with 1 water to 1 nitrile in molar ratio. The reaction consumes all the water for the production of amide, producing no wastewater. The reaction temperature can be set to nearly 180ºC, resulting in a faster reaction speed. The target amide can be obtained at a concentration of nearly 100 per cent.

*Source: techon.nikkeibp.co.jp*

## A cheaper way to clean heavily polluted water

A European research project has succeeded in developing a cheaper treatment system for wastewater from ships, oil refineries and other petrochemical industries contaminated with toxic compounds. The cost is just a tenth that of other commercial tertiary treatments, and the treated water is so clean that it can be pumped safely into the sea without endangering flora or fauna.

The most complete method of treating petrochemicals-contaminated wastewater is through a series of physico-chemical and biological processes. It is complex, requiring a combination of bioreactor, chemical coagulation, granulated activated carbon and sorption technologies. The tertiary stage is the most expensive part of the treatment and can cause problems such as fouling, undesirable bacterial growth and toxic sludge.

"We set out to find a stable process which was as cheap as possible," says Professor Viktoras Racys at Lithuania's Kaunas University of Technology, the main project partner in Eureka project "Euroenviron Biosorb-Tox". The research group at the university's environmental engineering department had already developed and tested a new wastewater treatment model on a laboratory scale. The project team came up with an ultra-efficient combination on an industrial scale: the three processes – sorption, bio-degradation and filtration – in one a reactor. The pollutants are degraded by the micro-organisms created within the reactor, Prof. Racys says.

The system is already functioning at Lithuanian oil company, Nasta. Prof. Racys says, "It has a high capacity, processing 160 $m^3$ per hour. The cost is €1 for every 3.5 litres. Effectively it is 10 or 20 times better than what else is available." The pollutant is reduced from 1 g to 0.1 g per litre of water. "This surpasses the EU standards and the water can be put straight back into the sea," claims Prof. Racys.

*Source: www.sciencedaily.com*

## Algae to benefit the mining industry

A type of algae is being developed to treat wastewater from the mining industry that contains heavy metal and acidic components. It would be the first time algae are used this way, and the developer, Mr. Jamie Miller of Somnium Innovations Pty Ltd., Australia, says that the algae technology was designed for use in acid mine drainage. "Acid mine drainage is a massive problem for the mining industry; it is a multi-billion dollar problem economically and an environmental problem and so we are seeing an opportunity in the industry to develop technology to treat this problem," Mr. Millier said. A prototype for the algae technology is expected by the middle of 2009.

*Source: www.abc.net.au*

## Mixing technology for anaerobic digestion

Philadelphia Mixing Solutions from the United States, has introduced Momentous Flow™ – the next generation mixing technology for anaerobic digestion in the wastewater, biofuels and agricultural markets. Compared with standard and egg digester technologies, this mixing system is claimed to offer much faster installation, lower operating and maintenance costs, and efficient generation of reusable energy from methane capture.

Momentous Flow uses a single Z/T = 3.0 axial impeller and no baffles in the upper part of the vessel to create centrifugal force. That force pushes membrane methane bubbles from anaerobic digestion to the centre of rotation, where they quickly coalesce and escape from the liquid into a collection cap. The methane is then harnessed to power digestion operations, significantly reducing or eliminating the need to power the equipment from the grid.

Momentous Flow equipment has a cone-shaped bottom and is much smaller than standard mixing equip-

ment. These design improvements drive down the cost of initial site construction and installation. Its single impeller requires less service time than traditional multi-mixer installations, reducing maintenance and repair costs. *Contact: Philadelphia Mixing Solutions, 1221 East Main Street, Palmyra, Philadelphia, PA 17078 9518, United States of America. Tel: +1 (717) 832 2800; Fax: +1 (717) 832 1740; Website: www.philamixers.com.*

*Source: news.thomasnet.com*

## The mining industry looks for greener technologies

With the spotlight on water conservation and all things green, the pressure is greater than ever for industries to explore better ways to use, treat and dispose of wastewater. Canada's mining industry has to meet very strict regulations, the enforcement of which is very severe. This has driven the industry to come up with new technologies to remain competitive within law.

BioteQ Environmental Technologies Inc. has developed an environmental technology that would make the mining industry greener. Its biologically based process can safely remove dissolved metals and sulphates from contaminated water at mining sites. In simple terms, the process uses specific reagents for the recovery work. The result is that wastewater is clean enough to pass muster with the guidelines for discharge to the environment or reuse in the mining process. Further, the materials extracted from the water can be sold as a source of revenue, which helps to offset the cost of treatment. This process is significant when one considers that the lime treatment typically used by mining operations to process wastewater leaves behind metal-laden sludge that requires to be stored, monitored and managed for many decades.

ProSep Inc., another Canadian firm, has developed an innovative technology for treating polluted water in offshore oil and gas operations. Total Oil Remediation and Recovery, or TORR, uses a coalescing element that separates solids from liquids. As the water passes through the membrane, it captures micro-sized oil droplets. In time, the oil accumulates to the point where it creates a film that eventually floats to the surface for safe removal.

TORR technology is already being used in oil rig operations in the North Sea, the Atlantic and the Middle East to treat "overboard discharge" from oil extraction operations. "This is one of the most difficult types of wastewater to treat because the size of the oil droplets averages four microns. Conventional technology simply can't treat that," claims Mr. Serge Fraser, ProSep's Vice-President, Corporate Development.

The unique nature of the oil sands has provided significant opportunities to explore new ideas, says Mr. Roger Jacklin, Marketing Executive at GE Water & Process Technologies, Canada. Older techniques for cleaning water used 'precipitators' to remove dissolved calcium, silica and magnesium. Like metal mining, this process formed a sludge that needed to be disposed of and monitored. "The industry is now going to technologies that reduce the amount of solids so water can be reused continuously," Mr. Jacklin explains.

Among the technologies from GE is an innovation called ZeeWeed. This membrane filtration technology for purifying drinking water is now being showcased as part of the city of Edmonton's Gold Bar project to minimize the stress on the North Saskatchewan River. The initiative permits water from the municipal treatment plant to be treated for reuse by the refinery operations.

*Source: www.cbc.ca*

## Orange peel to clean up industrial effluents

Algerian researchers have found that something as ordinary as orange peel could be used to remove acidic dyes from industrial effluent. "Synthetic dyes are extensively used by industries including dye houses, paper printers, textile dyers, colour photography, and as additives in petroleum products," explained Mr. Benaïssa Houcine of the Laboratory of Sorbent Materials and Water Treatment, University of Tlemcen.

The effluents of these industries are highly coloured, and their disposal into the environment can be very deleterious. Their presence in water courses may be visible at concentrations as low as 1 ppm. In looking for an alternative to chemical treatment of wastewater, Mr. Benaïssa considered a common food industry by-product, orange peel. He tested orange peel as an absorbent for the removal of four acid dyes from simulated samples of polluted water.

The research demonstrates that absorption time depends on the initial concentration of the dyes as well as the chemical structures of the particular dyes being tested, but absorption can occur at just 25ºC. Strong dyes such as Nylosane Blue, Erionyl Yellow, Nylomine Red, and Erionyl Red were absorbed at 40-70 mg/g of orange peel. Further research is now required to optimize and scale-up the process for the real-world clean-up of dye effluent. This will involve identifying the biochemical sites in the orange peel to which the dye molecules stick during absorption.

*Source: www.hindu.com*

## Off-site bioremediation technologies

Waste Management Inc., the United States, has developed a collection of innovative off-site remediation technologies to assist companies deal effectively with contaminated soils. These bioremediation services include the following.

TOSS℠ (Two-Step Static System) is a two-stage, solid-phase bioremediation technology that involves both anaerobic and aerobic treatments. In the first stage, explosives-contaminated soil is combined with a carbon source, an inoculum, vitamins and water to achieve anaerobic conditions. The resulting mixture is formed into a static pile or placed in a bermed construction or box to facilitate the chemical reduction of nitroaromatic and nitramine explosives. In the second stage, the anaerobically treated soil is combined with yard waste compost and built into an aerated biopile. The biopile is aerated by forced air conveyed through perforated piping buried within the pile or by turning the pile with a compost turner. Testing of TOSS has demonstrated TNT removal efficiencies of greater than 99 per cent.

The BioSite℠ System is for the large-scale bioremediation of soils contaminated with:

- Petrochemicals including, but not limited to: acetone, alcohols, benzene, ethyl benzene, methyl ethyl ketone, methyl isobutyl ketone, petroleum hydrocarbons, toluene, two- and three-ring PAHs, xylene; and
- Other contaminants, including: aliphatic chlorinated hydrocarbons (e.g., trichloroethylene), spent molecular sieve from packing towers, chemical manufacturing wastes, pesticides.

Regulated compounds including underlying hazardous constituents are screened prior to acceptance. Soils co-contaminated with metals may be accepted depending on their concentration.

Bio-In-A-Box℠ works on the same principles as BioSite and TOSS, but is designed to operate indoors on a relatively smaller scale. Instead of being formed into long earthen mounds, the contaminated soil is moistened, mixed with nutrients and custom-grown micro-organisms and then placed in enclosed containers called "solid phase bioreactors" for incubation. These containers may or may not be linked to aeration and vacuum pipes, depending on the contaminants being processed. In just a few weeks, the decontaminated soil will be ready for disposal in a landfill site or reintroduction into the environment.

*Contact: Waste Management Inc., 1001 Fannin, Suite 4000, Houston, Texas, TX 77002, United States of America. Tel: +1 (713) 512 6345; E-mail: WMCares@wm.com.*

*Source: www.wm.com*

## Fully sludge-free bioremediation

*BPC's bioremediation unit*

An Israeli company, BioPetroClean (BPC), has developed an innovative industrial wastewater treatment process that offers major improvements over existing solutions. The novel Automated Chemostat Treatment (ACT) creates an output that is virtually sludge-free and can be directly returned to the environment. BPC transforms wastewater treatment into a highly efficient, economical and ecologically friendly process applicable in numerous wastewater treatment challenges, ranging from oil refineries and storage farms to drilling sites, marine ports, stream water and reservoirs.

The scientific concepts behind ACT are the application of an appropriate bacterial cocktail for a given type of polluted water, and an innovative chemostat. The process maintains a balanced state of bacterial growth and organic compound degradation. Thanks to the low concentration of bacterial cells, no aggregates are formed, and each bacterium acts as a single cell that increases the surface available for the process and enables biodegradation at a much higher efficiency.

ACT operates as a continuous flow reactor without using an activated sludge. The bioreactor can thus be applied on site while using available infrastructure with high flexibility for modulation of the process, thus saving dramatically in operational and maintenance costs. The fully automated system consists of a variety of on-line sensors, which feed the control unit information on various parameters such as: TPH, nitrogen, dissolved oxygen, TOC and temperature. The controller ensures to maintain optimum process balance between the flow rate, bacterial growth, additives and organic compound degradation.

*Source: www.pollutionsolutions-online.com*

## Improved biological odour removal

Biorem Inc., Canada, has introduced the UNITY technology platform that improves the performance level

of biological odour removal systems. The innovation emerged from more than two years of advanced biofiltration and biotrickling media research.

At the heart of the UNITY platform are the two novel types of permanent media developed by Biorem. Harnessing the odour removal efficiency of these media is based on proprietary process and innovative tank configurations. The performance advantage is the high removal rate of both hydrogen sulphide and the very odorous contribution of total reduced sulphur while using a much smaller vessel. The advantage to owners and municipalities is a system with guaranteed performance with a small footprint and a lower overall installed cost, claims Mr. Peter Bruijns, President and CEO of Biorem.

*Source: www.wwdmag.com*

## Downwash process soil bioremediation system

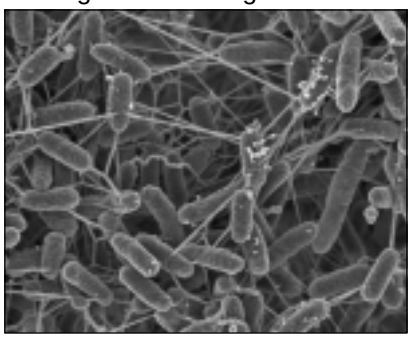
Vitabio Inc., the United States, has patented a method for the removal of petroleum hydrocarbon and toxic constitutes from contaminated soils and sediment. The remediation process is claimed to: remove major portion of the toxic constitutes from soils; improve the effectiveness of bioremediation for the remaining toxic constitutes in the soils; decompose the removed toxic constitutes in the preferred embodiment; and shorten the on-site treatment waiting period.

The invention aims to provide a bioremediation system that can treat a wide variety of toxic constitutes in soils, particularly for petroleum-based hydrocarbon materials. The method comprises the addition of a bio-stabilizer to promote bioremediation of contaminants in the soil. Fertilizer materials – such as amino acid, nitrogen fertilizer or NPK mixed types fertilizers – are added to improve the effectiveness of the bio-stabilizer.

*Source: www.freepatentsonline.com*

## Separation of carbon-based nanomaterials

In the United States, Mr. Fanqing Chen and Mr. Jay Keasling of Lawrence Berkeley National Laboratory have developed a technology that opens up new territory for bioremediation – providing for separation of carbon-based nanomaterials, such as fullerene waste, from a liquid mixture by the addition of bacterial cells. The invention has potential on two fronts: for removing soluble toxic nanomaterials from water and for using nanomaterials to control the growth of micro-organisms in a bioremediation system, thus preventing the biofouling of water.



*Shewanella oneidensis bacteria*

The process involves mixing bacterial cells with a suspension of nanoparticles and waiting for clumping to occur (approximately 30-45 minutes) before the resulting biomass is precipitated. Centrifuging or filtering may not be necessary, and the fullerene waste can be separated out easily. While the invention provides for the use of different organisms, the versatile and environmentally important bacterium *Shewanella oneidensis* MR-1 is the agent of choice as it is non-pathogenic and can grow in both aerobic and anaerobic conditions.

The invention provides a means of studying the charge-associated effects of fullerene derivatives on microbial structural integrity and also can be used to index the toxicity of nanomaterials by comparing isotopomer data with standards to detect the change of certain enzymatic reactions in cell metabolism under environmental and genetic stresses. Data on the regulation of enzymatic activities could be used in a high-throughput approach complementary to a microarray study.

*Source: www.clu-in.org*

## Bioremediation of oil refinery by-product using a fungus

In Egypt, Mubarak City for Scientific Research and Technology Applications – jointly with four inventors – has been assigned a WIPO patent on a process of bioremediation of oil refinery by-product using a fungal strain and its optimization through numerical modelling. One soil sample and two water samples were used for bioremediation, and quantitative and qualitative analyses.

The fungal strain was grown on a standard potato dextrose-agar medium and incubated until sporulation, and checked microscopically. The spores formed were characteristic for the genus *Penicillium*. Molecular characterization of the fungus by sequencing the 18SrDNA gene confirmed this identification. *Penicillium* sp. was not able to grow on the media without addition of oil as carbon source, indicating that the amount of yeast extract used to culture the fungus on samples was not adequate. The fungus was not able to grow on media without the addition of yeast extract in the presence of oil as a carbon source; may be because the yeast extract contains some other growth factors needed for fungal growth.

Casein, potassium phosphate dibasic ($K_2HPO_4$), yeast extract, spore suspension concentration, pH and trace elements promoted petroleum removal by *Penicillium* sp., while ammonium sulphate, urea, temperature and sodium chloride inhibited the oil bioremediation process. The results reflected the importance of phosphorus-containing compounds for the bioremediation process. High temperature and salinity inhibited the fungal capacity to degrade petroleum oil, pointing to the unsuitability of the fungus for removal of oil spills from marine environment and at high temperatures. The Plackett-Burman model created based on experimental results showed sodium chloride as the highest negative significant variable (98.8 per cent), and $K_2HPO_4$ was the highest positive significant variable (97.2 per cent).

Phosphate concentration, higher pH and spore suspension concentration increased the oil degradation capacity of the fungal isolate. After estimating the relative significance of independent variables, these three most significant variables were selected for further determination of their optimal level with respect to mean enzyme activity (units/ml) as a response. For this, Box-Behnken design, which is a response surface methodology, was applied. The main steps of this optimization process were: performing the statistically designed experiments, estimating the coefficients in a mathematical model and predicting the response, and checking the adequacy of the model.

The optimal levels of the variables as obtained from the maximum point of the model were: $K_2HPO_4$, 9 g/l; spore suspension, 4 per cent; and pH, 8.5, with a predicted optimum of 98.8 per cent oil degradation capacity. Application of Box-Behnken design to optimize the selected factors for maximal degradation is an efficient method that tests the effect of factors' interaction. It also converts the bioprocess factor correlation into a mathematical model that predicts where the optimum is likely to be located. *Contact: Mubarak City for Scientific Research and Technology Applications, New Borg El-Arab City, Alexandria, 21934, Egypt.*

*Source: www.freepatentsonline.com*

## Chemical-free perchlorate remediation system

Mr. John Coates and Mr. Cameron Thrash of the Lawrence Berkeley National Laboratory (LBNL), the United States, have developed a low-maintenance, chemical-free perchlorate remediation system in which a cathode functions as the electron donor for microbial perchlorate reduction in the working chamber of a bio-electrical reactor. The bacteria in this bio-electrical process are maintained at constant levels, eliminating the biomass disposal expenses that conventional microbial reduction systems incur. The invention is suitable for wellhead treatment of drinking water and on-site and off-site treatment of wastewater and contaminated ground water.

LBNL's remediation technology has been shown to work with both high (ppm) and low (ppb) levels of perchlorate concentration, as well as with natural ground water containing mixed perchlorate and nitrate, achieving 100 per cent treatment efficiency in all cases and volumetric loading rates as high as 60 mg/l of reactor volume per day. The system contains both a reductive and an oxidative environment within a single-chamber electrochemical cell. The cell consists of a cathodic graphite particle bed infiltrated with perchlorate-reducing bacteria, an anode, ports for inflow and outflow, and an electrical load.

The bacteria use the cathode surface as a source of electrons for perchlorate reduction. No additional organic carbon is supplied, thus limiting propagation of the organisms while stimulating their perchlorate reducing-activity. In addition to eliminating biomass disposal, the remediation system significantly reduces downstream issues that are associated with traditional bioreactors, such as biofouling, corrosion, as well as the production of trihalomethanes during disinfection of treated waters. This LBNL technology, which is patent-pending, is available for collaborative research or licensing.

*Source: www.clu-in.org*

**Global Computer Refurbishment and Recycling Partnership**

The Secretariat of the Basel Convention has developed the Global Computer Refurbishment and Recycling Partnership (e2e) programme to work towards increasing the recyclability and reuse of used computing equipment/computers and divert such end-of-life products from landfills. For more information, contact:

*Secretariat of the Basel Convention*
*13-15 chemin des Anémones*
*1219 Geneva, Switzerland*
*Tel: +41 (22) 917 8218; Fax: +41 (22) 797 34 54*
*E-mail: sbc@unep.ch*
*Website: www.basel.int*

## Hospital Sanitation and Bio-medical Waste Management: An Integrated Approach

The book is an outcome of studies on various aspects of hospital waste management. The book contains useful information on state-of-the-art technologies on bio-medical waste management and training packages. It deals with various aspects of bio-medical waste management such as: impacts on health and environment, sources and generation, classification and categories, collection, segregation and storage, handling and transfer, reuse, recycle, treatment and disposal technologies, management strategies, training programmes, legislative frameworks, etc. The book provides useful reference to the concerned personnel in the medical units all over India.

*Contact: Sulabh International Institute of Health & Hygiene, G-15, First Floor, Mandir Marg, Mahavir Enclave, Palam-Dabri Road, New Delhi 110 045, India. Tel: +91 (11) 2503 1243, 2505 8941; Fax: +91 (11) 2503 4014; E-mail: sulabh1@nde.vsnl.net.in.*

## Introduction to Plastic Recycling (2nd Edition)

As in the successful first edition, this book provides straightforward information on plastic materials and technology, including the options for recycling plastics, with special focus on mechanical recycling. It touches on all the major problems associated with recovering and recycling plastics at a level intended to be accessible to any reader with an interest in this field, whatever their background. It also looks at some of the broader issues surrounding successful waste management of plastics.

This new edition reflects the great strides that have been made to increase plastic recycling rates worldwide in recent years. It considers the expansion of infrastructure to support plastic recycling and major achievements that have been made in gaining widespread public support and participation for recycling schemes; specifically the need to manage waste on a household level. Current issues surrounding council recycling of plastic bottles, and the practice of providing free plastic carrier bags by supermarkets, are also considered.

*Contact: Woodhead Publishing Ltd., Abington Hall, Abington, Cambridge, CB21 6AH England, United Kingdom. Tel: +44 (1223) 891 358; Fax: +44 (1223) 893 694; E-mail: wp@woodheadpublishing.com.*



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15463 Kuwait.
Tel: +965 434 2828;
Fax: +965 433 0809;
E-mail: info@kuwaitwaste.com.

**18-20 Jun**
Beijing
China

**CHINA ECO EXPO 2009**
Contact: Global Eco Expo,
15030 Ventura Boulevard,
Sherman Oaks, CA 91403,
United States of America.
Tel: +1 (818) 906 2700;
Fax: +1 (818) 986 5890;
E-mail: info@ecoexpo.com.

**24-26 Jun**
Toronto
Canada

**EBR 2009**
**International Electronics & Battery Recycling Congress**
Contact: International Congress & Marketing AG,
Schwaderhof 524, 5708 Birrwil,
Switzerland.
Tel: +41 (62) 785 1000;
Fax: +41 (62) 785 1005;
E-mail: info@icm.ch.

**8-11 Aug**
Harbin
China

**Sustainable Management of Water and Wastewater Sludges**
Ms. Livia Ding,
Organizing Committee,
No.202 Haihe Road, Nangang,
Harbin 150090, China.
Tel: +86 (451) 8628 3777;
Fax: +86 (451) 8628 3082;
E-mail: iwasludge2009@yahoo.cn.

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## PERIODICALS

(Free access at www.techmonitor.net)

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- ❑ VATIS Update (6 issues/year)
  - ❍ Biotechnology (e-version)
  - ❍ Non-conventional Energy (e-version)
  - ❍ Food Processing (e-version)
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  - ❍ Waste Management (e-version)

## BOOKS

| | Indian Rupees* (India, Bhutan and Nepal) | US Dollars* |
|---|---|---|
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| ❑ Regional Capacity-building for the Adoption of ISO-14000 and Transfer of Environmentally Sound Technology: Training Manual, 2000 | 600.00 | 30.00 |
| ❑ Small Rural Industries in the Asia Pacific Region: Enhancement of Competitiveness of Small Rural Industries in a Liberalized Economic Environment and the Impact of Poverty Alleviation, 2000 | 600.00 | 30.00 |
| ❑ Technology Transfer and Technological Capacity-building in Asia and the Pacific | | |
| ❍ Volume 1: Big Countries and Developed Economies, 1999 | 600.00 | 30.00 |
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| ❑ Development and Utilization of S&T Indicators: Emerging Issues in Developing Countries of the ESCAP Region, 1998 | 300.00 | 15.00 |
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| ❑ Proceedings of the Consultative Meeting on Technology Management Education and Training for Developing Countries, 1997 | 800.00 | 40.00 |

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