Metal recycling breakthrough will enable firms to clean up and reduce costs

New electrochemical process recovers precious and heavy metals from industrial waste, saving water treatment and landfill charges

New technology for metal recovery and recycling could help industry to meet increasingly strict environmental standards cost effectively, it was announced today (20th September 2002). Significant savings in running costs and disposal costs are claimed for the new electrochemical process, which will reduce discharge of potentially toxic chemicals in water and eliminate needs for landfill disposal.

Developed at Brunel University as part of a wide-ranging waste minimisation initiative backed by Government and industry, the process can recover a wide range of metals from industrial effluents. Instead of having to pay for treatment of wastewater and disposal of contaminated sludge, firms will be able to recycle and sell valuable metals such as cobalt, copper and iridium. 'Until now, most heavy metals in industrial effluent have been precipitated out and gone to landfill,' explains project leader Professor John Donaldson of the Centre for Environmental Research at Brunel University. "We set out to devise an economic electrochemical method to eliminate landfill and recover the metals.'

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'The process will enable firms to meet increasingly strict legislation and reduce the amount they have to pay for disposing of effluent. It should be a highly saleable and successful technology, with potential markets all over the world.'

Companies can obtain individual advice from the Centre for Environmental Research on how to tackle specific metal recovery and recycling problems. 'As time goes on, more and more firms will need to treat specific types of effluent,' adds Professor Donaldson. 'We can tell them fairly quickly whether the technology is right for them.'

The process has been pioneered as part of the Government's programme for Waste Minimisation through Recycling, Re-use and Recovery in Industry. The Engineering and Physical Sciences Research Council and the Department of Trade and Industry provided grants of approximately £200,000 for the three-year project. Industrial partner Fluid Dynamics International Ltd provided additional support and is marketing the technology, which is the subject of two patent applications.

The new process overcomes shortcomings that have ruled out existing alternatives. Until now, electrochemical recovery has been too expensive because metal concentrations are usually very dilute. Conventional electrochemical cells require large electrical currents and cannot achieve standards required by water and sewage treatment companies.

The key to success has been the development of a new type of electrochemical cell. Known as a concentrator cell, it increases efficiency by concentrating metal ions close to an electrode, allowing much larger amounts of metal to be recovered. Concentrator cells are suitable for in-process or end-of-pipe recovery installations. They maintain a constant pH, so there is no need to add alkali as in standard cells. In addition, they can simultaneously remove organic pollutants which would reduce efficiency of metal recovery and contaminate wastewater.

WMR3
(Waste Minimisation through Recycling, Re-use and Recovery in Industry) was a collaborative industrial research programme supported by £12m of funding from EPSRC and DTI during 1995 – 2003.

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Results of trials show that concentrator cells can successfully treat metal solutions commonly produced in processes ranging from plating to etching of printed circuit boards, refining of platinum group metals, printing, galvanising and distilling. The cells are equally effective in recovering high value metals such as iridium, silver and cobalt as well as toxic heavy metals such as lead and cadmium. Potential cost savings of £6,000 per tonne have been achieved in a typical application to recover cobalt from mining waste. With iridium, one of the most difficult of the platinum group metals to recover, a concentrator cell can recover 80% of the metal content of waste.

'The economics are moving steadily towards making this an attractive solution,' says Professor Donaldson. 'First there is the return on the metal recovered. For iridium, that could be as much as £33,600 per tonne of solution. Secondly, firms can reduce the amount they have to pay to dispose of effluent. That will be an increasing saving as strict new legislation comes into force.'

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Additional project details and background

What happens to metals in industrial process waste at present?

Most heavy metals that appear in industrial effluent are precipitated out and consigned to landfill in the form of hydroxide waste sludge. The cost of landfill is rising and it will be increasingly important to find alternative disposal methods. Stricter legislation will require maximum amounts of metals to be recovered and impose tighter control on wastewater content.

Why aren't alternative disposal methods being used already?

Potential alternatives for removing metal content have not been economic until now. Ordinary electrochemical cells are inefficient in dealing with the low concentrations of metals usually encountered in industrial process solutions. The presence of organic contaminants can reduce efficiency of electrodeposition still further.

What makes the new concentrator cell more effective?

The concentrator cell concept concentrates metal ions close to one of the electrodes (usually the cathode). The result is to reduce the distance that ions have to travel – in effect creating a new cell with a concentrated electrolyte at the electrode. As a result, metals can be captured and then released on to the cathode surface much more effectively. Unlike standard cells, there is no need to maintain pH by continuously adding alkaline solution. The concept can be combined with other techniques, such as membrane technology to separate nickel from cobalt, and to regenerate chromium from industrial etching solutions.

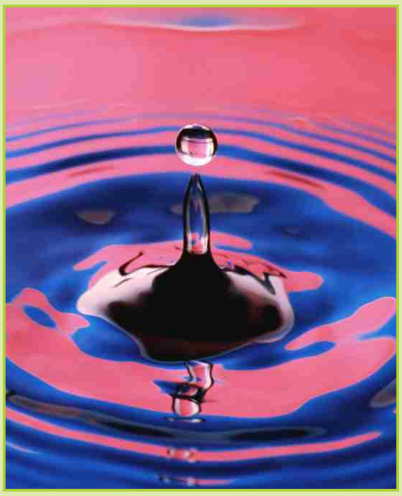
How does the concentrator cell deal with organic contaminants?

Organic contaminants in mixed industrial effluent can make it costly and difficult to recover metals from many industrial effluents. Concentrator cells can be combined with photolytic cells to achieve simultaneous destruction of organic contaminants and collection of metals. The combined system has been successfully tested with a range of mixed effluents.

How widely can the new process be used?

In trials, more than 50 industrial samples have already been successfully treated. Examples include:

Industry	Analysis (mg/litre)
Distilling	Cu 430
Distilling	Cu 13 + organic pollutants
Galvanising	Zn 8 500
PCB etching	Cu 127 600 + Fe
PGM refining	Ir 640, Pb 1 770
PGM refining	Ir 59 , Pd 495, Cu 13 000
Plating	Ag 7 600
Plating	Co 23 000
Plating	Cr 69 000 + Cu, Zn, Ni
Plating	Cr 29 750, Zn 2 560
Printing	Cu 13 + organic pollutants
Tin plating	Sn 11 100



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