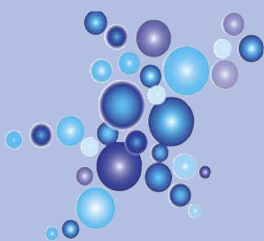


# Enviro Biotext

News from the Environmental Biotechnology CRC



Ian Kiernan AO  
EBCRC Chairman

## This issue:

Message from  
EBCRC's Chairman

Pathogen Detection  
using Biotechnology

Can EBCRC develop  
your great idea?

What's in the Product  
Pipeline

EBCRC People Profile

Upcoming Events

Contact and  
Publication Details

*Biotechnology  
benefiting the  
environment*

## Clean up is more than Clean Up Day

With the upcoming Clean Up Australia Day on 6 March 2005 I am reminded that over the years how much we have achieved in cleaning up the visible forms of waste that pollute Australia.

However, my Chairmanship of the Environmental Biotechnology CRC highlights that there is more to pollution than the visible forms that our Clean Up program addresses so successfully.

As humans have moved from the low intensity village settlements to the mega-cities of today's environment, we have stressed the systems that naturally clean up our pollutants.

We have also introduced new chemicals that nature never intended should be left as legacies for the world.

Even if these systems are not stressed, most are inadequate to cope with the rate at which wastes are produced and require processing.

But there is hope. New techniques in biotechnology developed from biological and health sciences allow us to assist the naturally occurring microbial systems in converting wastes more efficiently and effectively.

More than this we hope that these techniques will allow us to make new products from these sources.

Wastes will no longer be the last part of a disposal chain but become valuable resources for new bioproducts that will not have the unwanted side-effects of pollution and contamination.

The EBCRC is dedicated to achieving the ideal of using biotechnology for a cleaner and more sustainable world.

It will use complex natural microbial systems enhanced by advanced techniques that will enable them to provide commercially viable processes for the detection, bioconversion and remediation of contamination.

This is our first newsletter for external readers. It gives examples of some of the biotechnology applications and R&D that are going on in the CRC.

This and future editions will provide glimpses of some of the future products that will indeed demonstrate that we provide 'Biotechnology that benefits the Environment'.

We will also shortly be starting a series of seminars to help convey the extent of the work Australia is doing in this new and exciting sector. Have a look at the EBCRC's web site ([www.ebcrc.com.au](http://www.ebcrc.com.au)) for more details as they appear.

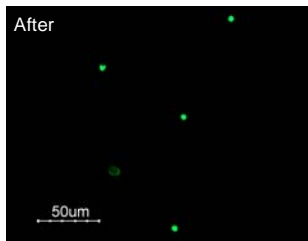
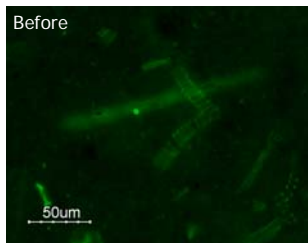
Welcome to the world of environmental biotechnology.





## Pathogen detection using biotechnology

**Macquarie University's Prof. Peter Bergquist explains the Pathogen R&D team's research into rapid and cost-effective identification of pathogens in the environment.**



The Before picture is industry wastewater collected onto a membrane and stained. One *Cryptosporidium* organism is observed amongst an array of detrital material which is hampering microscopic detection. The After picture is the same sample following purification by fluorescence activated cell sorting. A significant reduction in contaminating material is observed with 4 times more *Cryptosporidium* observed and *Giardia* also being identified.

The EBCRC is developing small, inexpensive biosensors for continuous real-time monitoring of water streams.

This project depends on some particularly sophisticated molecular biological, biophysical and electronic approaches.

The rapid detection of pathogens, particularly the parasites *Cryptosporidium* and *Giardia*, has been developed using flow cytometry.

In this process, a fluorescent marker is attached to the organism so that it can be seen with a water-based laser system.

Unlike drinking water, many waste-water streams are contaminated by organic materials.

The EBCRC is looking to expand and improve the specificity and sensitivity of detection procedures, and better isolate specific microorganisms from contaminating material.

Nanocrystals known as quantum dots are now being trialled by EBCRC as a replacement for the fluorescent organic dyes previously used.

Semiconductor quantum dots were originally developed for use in computers but have many advantages over the dyes currently used to label and visualize cells and their components.

Their labelling signals are brighter and much more photostable. By altering their size, they can also be made to emit light of any desired wavelength.

Quantum dots can be coupled to larger structures by standard chemistries used for biological detection of organisms.

Theoretically, thousands of colours can be generated. Practically, it should be possible to assay simultaneously for up to 20 pathogens in real time by flow cytometry.

A key outcome of the Pathogen team's work will be a simple field test for the presence or absence of designated pathogens that can be used by unskilled personnel.

This procedure uses a credit-card sized dipstick test conceptually similar to testing home swimming pools for water quality. It relies on a simple visual comparative test that indicates qualitatively whether a pathogen is present or absent.

It is expected that the credit card-type assay will be able to be manufactured for between \$1-\$2 per test.

The prototype can only detect single pathogens in the current format. However, a more sophisticated form is envisaged that could use multicolour detection of several pathogens in the one assay.

**A credit-card sized field test for the presence of pathogens could be used by unskilled personnel**

EBCRC researchers are also developing prototype systems for insertion into food production and processing facilities to detect the presence of specific human and animal pathogens of importance to the meat and other food industries.

The current focus is on abattoir waste water and other effluent streams. However, the technology developed has wider application in other industry settings such as farms, intensive animal production facilities, commercial and recreational fisheries and sewage works.

A feature of each of the experimental approaches employed in this project is that they constitute platform technologies.

Their use is not limited to the identification of environmental pathogens in wastewater, but can be applied to any organism for which a specific identifying sequence is available and which grows in any medium.

Hence they could be adapted for other applications such as specific medical diagnoses and for border protection and biodefense assays.

Some of the assays being developed can be coupled to the biosensors for the continuous real-time analysis of microorganisms in water streams of several types and origins.

EBCRC's expects to have a prototype for our dipstick technology by mid 2005. This would then be developed for testing and sale by the end of the year.





## Got a great idea and need some help?

The key to business growth and profitability is to continually bring new products and services to an awaiting market.

Innovating companies will stay one step ahead of their competitors.

New product ideas are important to us.

We are continuously looking for new product ideas where environmental biotechnology can provide an innovative solution.

We are interested in forming new relationships to bring new products and inventions to market, and in sourcing new ideas for our development.

If you have a new product idea or an invention or innovation related to environmental biotechnology we would love to hear from you.

Give EBCRC's Deputy Director Keith Steele a call on 0410 127 161, or email him at: [k.steele@ebcrc.com.au](mailto:k.steele@ebcrc.com.au)

## What's in the EBCRC Product Pipeline

**What sort of products would you expect to be developed by the Environmental Biotechnology Cooperative Research Centre?**

**To whet your appetite, here are just a few examples.**

### **Field Test Kits to detect pathogens**

Recent scientific advances have made it possible to incorporate very sophisticated science into simple test kits.

This will allow inexperienced operators to rapidly detect the presence of pathogens in real time.

The product will be a robust, accurate and rapid field test kit to detect the presence of *Cryptosporidium* and *Giardia*.

The initial market will be wastewater treatment operators but the product will also be applicable to the food industry. It will assist in the adoption and maintenance of systems to conserve one of Australia's most precious resources - water.

### **Smart chemicals and novel strategies to control or eradicate bacterial biofilms**

EBCRC's first patent applications will provide the basis for a range of "smart" chemicals and novel strategies to prevent or eradicate bacterial biofilms.

Biofilms constitute a major problem in all industries that deal with flowing water systems, eg drinking water and wastewater.

This leads to reduced bioprocess efficiencies, corrosion, and the persistence of pathogens, resulting in significant increases in costs.

### **Self cleaning paints and coatings**

Tired of cleaning algae off the outside of your house or grease from the walls of your kitchen or bathroom? Well the answer may be on its way!

Enzyme based paints and coatings that will prevent fouling and will be self-cleaning are in the early stage of product development. The enzyme based approach is a non-toxic, targeted approach to fouling inhibition.

### **Bioremediation products**

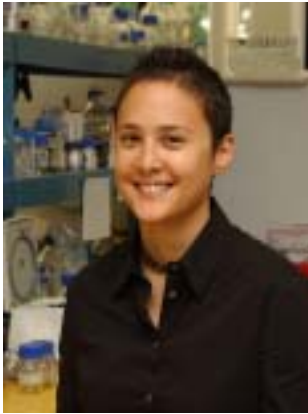
A product range is being developed that will include bacterial strains and consortia for bioremediation of sites contaminated with chlorinated hydrocarbons.

By harnessing bacterial communication networks we can manipulate the activities of naturally occurring microbial communities to clean up polluted environments.





## EBCRC Profile: Melanie Gengos



One of EBCRC's first students, Melanie is carrying out her PhD project at Macquarie University, Sydney.

Her thesis project is entitled "Cryptosporidium & Giardia as model pathogens: Detection within industrial wastewater"

*Cryptosporidium* and *Giardia* are waterborne protozoan parasites that are ubiquitous in the environment. Both parasites have been the cause of several waterborne outbreaks of diarrhoeal disease, and are therefore of considerable concern to water utilities worldwide.

Analysis of finished water usually involves concentration of large volumes of water by membrane filtration or flocculation followed by *Cryptosporidium* concentration using immunomagnetic separation (IMS).

A fluorescently labelled antibody is used to aid in microscopic detection of *Cryptosporidium*.

To date Melanie and the pathogens team have successfully modified the current assay to incorporate the simultaneous detection of *Giardia* in control water samples by concentration and flow cytometric detection with fluorescently labelled antibodies to each pathogen.

By implementing the use of permanently dyed *Cryptosporidium* and *Giardia* Melanie has been able to calculate detection limits for both pathogens.

EBCRC has now examined two diverse wastewater samples by this same method with promising preliminary results (see figure below).

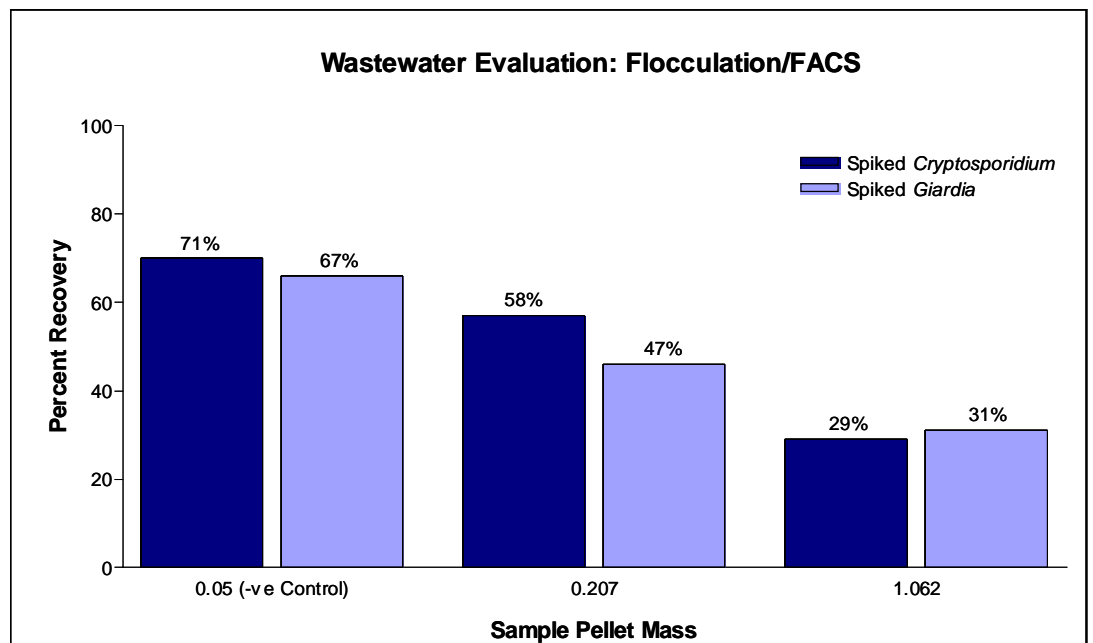
The aim of Melanie's PhD project is to develop a rapid and sensitive method for detecting these pathogens in industrial wastewater. At present, there are techniques available to detect *Cryptosporidium* in finished water and faeces.

Melanie obtained her undergraduate degree at the University of NSW, majoring in microbiology and immunology.

During her Honours year Mel examined the role of several proinflammatory cytokine polymorphisms, and environmental and bacterial virulence factors, in the aetiology of gastric cancer in *Helicobacter pylori* infection.

Due to current water shortages, the reuse of industrial and treated wastewater is gaining more interest.

**Wastewater evaluation** using concentration and flow cytometric detection. 100 permanently dyed *Cryptosporidium* and *Giardia* were spiked into each water sample, with preliminary results indicating an inverse correlation between sample pellet mass (how dirty the wastewater sample is) and spiked *Cryptosporidium* and *Giardia* recovery





## Upcoming Events

### Environmental Biotechnology CRC Seminar Series

## Making more with less: Improving nitrogen use efficiency of sugarcane

*Dr. Nicole Robinson*

presented by the  
**CRC for Sugarcane Biotechnology**

Don Carruther's eXchange Zone  
Level 5 Dorothy Hill Physical Sciences Library  
University of QLD  
**4 pm 16 February**

Light refreshments provided

*Biotechnology benefiting the environment*



## Contact and Publication Details

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### Annual Report 2003-2004 on Website

Our 2003-2004 Annual Report can be found on the CRC's website  
([www.ebcrc.com.au](http://www.ebcrc.com.au))

For a CD version, or a copy of the Highlights Brochure,  
please contact Communication Manager Pepita Maiden on 02 9209 4969, or  
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