Bacteria to spot pollution

January 17 2013, by By Anthony King

Scientists are recruiting bacteria to spot pollutants spilling into our rivers and lakes.

Natural sensory system such as bacteria engineered to detect pollution and placed in a self-contained portable box could be the most effective way to track pollutants. Such devices are being developed as part of BIOMONAR, an EU-funded project which follows on from its predecessors, ECODIS and TOXICHIP. "Bacteria like all living beings have very specific sensory proteins, which enable the [bacterial] cell to find its way around and detect toxic or edible chemicals," Jan van der Meer, project microbiologist at the University of Lausanne, Switzerland,

tells youris.com.

The project team relied on bacteria coupled to a molecular reporter system that is easily visible. As a result, bacteria light up through bioluminescence once the target chemicals are sensed. "Much of what we do is designing and testing genetic circuits, small pieces of DNA which contain the necessary information for the cell to produce the reporter signal in response to the environmental target compound," says van der Meer. For example, he has developed a biosensor to detect arsenic as a contaminant in drinking water by genetically engineering Escherichia coli bacteria.

Nevertheless, this approach has limitations. Biosensors developed by project scientists do not reveal what is in the water; just that it is toxic to the bacteria, which is sometimes all we need to know. However, this method compares favourably to previously developed chemical pollution sensors. "The advantage of live cells is that they can report biological effects, in other words they can tell you what a biological system feels," comments Shimshon Belkin, a project scientist at the Hebrew University of Jerusalem, Israel, adding: "no chemical method can provide this information."

Besides, these kits could help go beyond regulatory requirements. "Regulations would mandate testing of maybe 100 chemicals, but you test only for these chemicals. If you get chemical 101, you will never find it, because you will not be specifically looking for it," Belkin tells youris.com, "but these toxicity assays will discover its presence."

However, industry is unlikely to adopt this approach unless mandated by authorities. There is a need for "clear legislation that will ask the user in industry to [follow] pollution quickly and frequently," comments Gérald Thouand, a scientist at the University of Nantes, France, not connected to the project. He is working on bacterial sensors for detecting heavy

metal pollutants in waste waters from treatment plants.

There are further challenges that still must be overcome before the bacterial alarms are widely deployed. "You can use genetically modified microorganisms for your own use in the laboratory and in some cases in a closed and defined area, but not in the environment. It is very, very difficult," adds Thouand. Indeed, releasing live species into the environment is very different from a containment process in a lab, concurs Brian Wynne, professor of science studies at Lancaster University, UK. "I think people will rightly ask questions about whether we can trust the containment process," he tells youris.com. But he notes that microorganisms may well prove easier to contain than genetically modified crop plants.

The next big problem scientists must address, notes Thouand, is the problem of mixed pollutants. "A pollutant can be more toxic or less toxic when in contact with other chemicals. For the environment, we need to address this problem in the decades to come and only live cells will answer the problem."

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Citation: Bacteria to spot pollution (2013, January 17) retrieved 26 June 2024 from https://phys.org/news/2013-01-bacteria-pollution.html