Call for greater focus on risks of toxic mixtures

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Mixtures of toxic chemicals that commonly occur in the word's cities may hold greater risks for citizens exposed to them than do the individual chemicals themselves.

Scientists from the Cooperative Research Centre for Contamination Assessment and Remediation of the Environment (CRC CARE) and University of Queensland are working to disentangle the enormously complex issue of whether a mixture of known toxins is more dangerous than the toxins are individually.

Reporting some early results at the CleanUp 2015 Conference in Melbourne, Professor Jack Ng said that studies of mixtures containing up to four polyaromatic hydrocarbons and the heavy metals and metalloids arsenic, cadmium and lead, appeared to have a slight additive effect in causing more of the kinds of genetic mutations likely to result in a cancer.

"At this stage we cannot categorically say that mixtures are more dangerous to human health than the different toxins taken one at a time – but when we study the ability of these mixtures to cause genetic mutation, in some mixtures there appears to be an additive effect."

The research is seeking to clarify the bioavailability (i.e. the ability of these chemicals to be absorbed by living creatures, including humans), interaction and toxicity of various combinations of the seven contaminants commonly found in polluted industrial sites and the

groundwater beneath them.

It follows rising concern worldwide that, with 144,000 man-made chemicals registered for use globally and 1000 to 2000 new ones coming on the market each year, humanity is increasingly exposed not just to a few substances but to complex mixtures containing dozens or even hundreds – some toxic and others completely unknown in their effects on health.

Prof. Ng says that mixture toxicity still depends mainly on the concentration and dose of the individual toxins but in some cases they may act in combination to have greater genetic effects – while in other mixtures some substances may act chemically to reduce the toxicity of others.

"No doubt the potential for harm is always there. That said, we have better management and regulation now, particularly in developed countries," Prof Ng states.

"Every chemical and every combination of mixture will have a threshold level for toxicity. This is also true in terms of chemical interaction whether before or after absorption by the body. It goes back to threshold, concentration and soil properties (and many other factors) that govern toxicity of certain mixtures.

However, he says that countries should definitely be doing more to monitor and understand the toxicity of complex mixtures over time, since that is what their citizens now face.

"Fast-throughput in vitro screening assays are the way to go. The big push for the so-called 'in vitro toxicology of the 21st century' may get us there one day. However, economic factors are the main obstacle to science uncovering more answers to this vital issue.

"In an ideal world we would have much stricter control and full toxicity studies for every significant chemical product or mixture. But that is not going to happen under the present science funding arrangements – at least not until someone develops a reliable, fast-throughput affordable screening system."

Prof. Ng says Australia is the envy of its neighbours as far as environmental quality is concerned and the country is "not doing too badly" when it comes to understanding the effects of mixture toxicity. "That doesn't mean we can't do more, and better. There is a lack of long-term vision among our leaders for the risks faced by modern society. They are too busy fighting for their political survival.

"All countries, including Australia, should have more long-term environmental projects that run for decades rather than the current 3- or 5-year grant cycles. At present, many projects duplicate each other's work over different time periods or methods.

"This is financially wasteful and we are missing continuity and cohesiveness. Long-term studies will provide better insights of the fate of chemicals and their environmental and health effects.

"At present most studies (particularly epidemiological ones) identify a disease and then attempt to guess the exposure that might have caused it, years or decades ago. In other words, we are trying to do things back-to-front, when we should be studying actual environmental exposure of people to toxins in real populations, at low doses and over long periods of time."

Provided by CRC CARE