Filter out trouble

Gold and silver nanoparticles remove pesticides from water

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By T V Jayan
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chemists at the Indian Institute of Technology (iit), Chennai, have developed a nanoparticle-based technique to remove pesticides from drinking water. The feat is noteworthy, for exposure to pesticides can trigger genetic mutations and neurological disorders. The method was developed by A Sreekumaran Nair and T Pradeep from iit's Department of Chemistry and the Regional Sophisticated Instrumentation Centre respectively. It exploits the unique tendency of gold and silver nanoparticles to adsorb traces of the chemicals.

During their experiments, the scientists used gold particles with a diameter of 10 to 20 nanometres (nm) and silver nanoparticles with a diameter of 60 to 80 nm. The particles were capped with a chemical called citrate (in other words, they were mixed in a diluted solution of the chemical using the reduction process); thereafter, they were put into water tainted with endosulfan, malathion or chlorpyrifos pesticides.

A change in the colour of the nanoparticles indicated the adsorption of the pesticides; for instance, the colour of gold particles changed from intense red wine to shades of blue when they adsorbed endosulfan. The change is due to the binding of the pesticides with the particles and the subsequent aggregation of the latter. The colour change varies, depending on the amount and type of pesticides.

To verify the laboratory results in the field, the scientists loaded the nanoparticles onto columns used in water filters available in the market. Thereafter, they passed water tainted with chlorpyrifos (concentration: one part per million) through the column. When the water was tested using the gas chromatography method, no traces of the pesticide were detected, the scientists claim.

They made yet another discovery -- the nanoparticles could also destroy halocarbons like chlorofluorocarbon, carbon tetrachloride and bromoform, which are toxic compounds resistant to microbial degradation. Unlike the physical entrapment of pesticide residues, the nanoparticles inactivate halocarbons through chemical reaction. When treated with citrate solution containing gold or silver nanoparticles, the halocarbons break down into amorphous carbon and halides of either silver or gold, depending on whatever metal is used.

and gold particles acquire a pale yellow hue. The efficacy of the nanoparticles is gauged through the surface plasmon resonance technique, which is widely used in biosensors; it detects whether the solution yielded after the process contains the nanoparticles or not. Their absence implies the halocarbons have been converted; formation of metal halides is confirmed separately.

Useful commercial application The scientists have already found a means to commercially exploit their knowledge. They have coated the gold particles on candles and filters commonly used to purify water. "As a result, these filters will not only trap microbial contaminants, but even minute particles of pesticides," Pradeep told *Down To Earth*. The scientists have already licensed the yet-to-be-patented technology to Eureka Forbes -- the manufacturers of Aquaguard, India's most popular drinking water purifier.

The researchers are now exploring the use of the technology for the remediation of organochlorines such as ddt and lindane, which persists in the environs for decades. Preliminary results show that "near complete removal of ddt from water" can be achieved.