Test finds manufactured nanoparticles don't harm soil ecology

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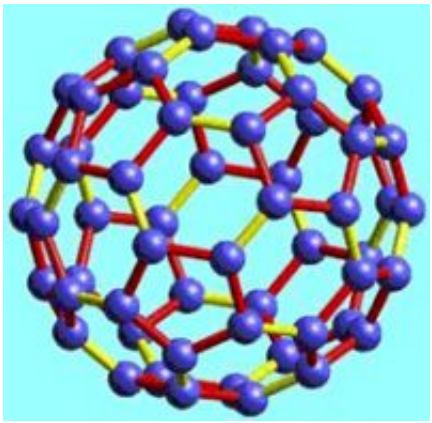

The first published study on the environmental impact of manufactured nanoparticles on ordinary soil showed no negative effects, which is contrary to concerns voiced by some that the microscopic particles could be harmful to organisms.

Scientists added both dry and water-based forms of manufactured fullerenes - nanosized particles also known as buckyballs - to soil. The nanoparticles didn't change how the soil and its microorganisms functioned, said Ron Turco, a Purdue University soil and environmental microbiologist.

Concerns surround the increased use of nanoparticles in everything from

car bumpers, sunscreen and tennis balls to disease diagnosis and treatment. Questions have arisen about whether the microscopic materials could trigger diseases if they enter the soil or water through manufacturing processes or if medicines based on nanoparticles behave in unexpected ways in the body.

Turco's research team designed its study to test how different levels of buckyballs affect soil microorganisms, including bacteria that are responsible for breaking down organic material and producing carbon dioxide and other compounds. Results of the study are published online and in the April 15 issue of the journal *Environmental Science and Technology*.

The scientists collected information from soil found in farm fields, and then they mixed in buckyballs. The research results will serve as baseline data for comparison as research progresses on all types and sizes of nanomaterials, said Turco, the study's senior author.

"Fullerenes will be in the soil eventually, so it's good to know they aren't affecting soil microorganisms," he said. "Bacteria in the soil are the basis of the food chain, so you don't want to change them because then you affect everything up the food chain - plants, animals, people."

Two levels of carbon-based buckyballs were tested in soil collected from no-till plots at the Purdue University Agriculture Research and Education Center located northwest of the campus.

Dry buckyballs and buckyballs suspended in water were added to the soil in levels of one part per million parts of soil and 1,000 parts per million parts of soil. Over a six-month period, the scientists monitored the size, composition and function of the bacterial community in the soil samples.

Carbon dioxide levels in the soil, or soil respiration, the soil microbes'

response to added nutrients, and enzyme activities in the soil were measured. No significant differences were found in soil containing no added nanoparticles and soil samples with either the low-level or high-level of buckyballs, the researchers reported.

If buckyballs were toxic to the soil environment, a reduction in the rate of carbon dioxide production, bacterial community activity and size, and enzyme activity would be expected, Turco said. Enzymes are produced as the bacteria degrade things such as organic matter.

"We thought we would see something negative in soil due to effects of fullerenes, especially at 1,000 parts per million," he said. "Lo and behold, much to our pleasure and surprise, our data shows no adverse effects on the soil microbiology."

Although some previous studies by other scientific groups concluded that buckyballs are toxic to microbes and, therefore, would be harmful to plants and animals if released into soil, Turco's research team doesn't believe that's the case.

"The results that have shown a negative effect from fullerenes are important and suggest a need for further investigation, but they did their studies in a purified culture," Turco said. "You can't look at the effects of manufactured nanoparticles in isolation. You have to put them in a natural environment where other things are reacting with the nanoparticles."

Naturally occurring microbes, organic matter and salts in the soil controlled the exposure level and toxicity of fullerenes, Turco said.

Purdue researchers are continuing a number of different studies on varying concentrations of nanoparticles of different sizes and made of different materials to find out if their effects vary from those found so

far, he said. Nanoparticles range in size from 1 billionth to 100 billionths of a meter and can be many different shapes.

"Clearly, each manufactured nanomaterial is different so we do need to develop a better knowledge of each on a case-by-case basis," Turco said.

Buckyballs, or fullerenes, are multisided, nanosized particles that look like hollow soccer balls. The full name for the cluster of carbon atoms is buckminsterfullerene, after the American architect R. Buckminster Fuller. His design for the geodesic dome is much like the shape of Buckyballs.

First found in a meteorite in 1969, buckyballs are among three known naturally occurring pure carbon molecules. The others are graphite and diamonds. Experts say that tiny carbon-based manufactured nanotubes are 100 to 1,000 times stronger than steel. Turco and his colleagues will study nanotubes in future research.

In 1985 researchers began making buckyballs, which led to a Nobel Prize for two Rice University scientists.

Source: Purdue University