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June 5, 2015

Susan Lewis
Director, Registration Division, Office of Pesticide Programs
Environmental Protection Agency
Office of Pesticide Programs, Mail Code 7506C
1200 Pennsylvania Ave. NW
Washington DC 20460

Re: Pesticide Product Registration; Receipt of Applications for New Active Ingredients
Docket No. EPA-HQ-OPP-2015-0169

Dear Ms. Lewis,

Thank you for this opportunity to comment on the application to register a new pesticide product. This comment is specific to the applicant Dune Sciences, Inc. on the product NSD20, which contains the active ingredient of silver nanoparticles at 0.45%.

Billions of dollars' worth of products containing nanomaterials have been available to consumers for many years now. Many nanoparticles like nano silver have been widely used in many products for their antibacterial properties. Nano silver is the most commercialized nanomaterial seen in products ranging from household appliances and cleaners to clothing, cutlery, and children's toys to personal care products and electronics. Due to its unique antibacterial properties, silver nanoparticles have been hailed as a breakthrough germ killing agent and have been incorporated into a number of consumer products.

While nanotechnology may have useful and promising applications, there are big unanswered questions about its potentially harmful and long-term effects on our health and the environment.

Silver Nanoparticles and Human Health

Many consider silver to be more toxic than other metals when in nanoscale form and that these particles have a different toxicity mechanism compared to dissolved silver. The main routes of exposure for humans would be the respiratory system, gastrointestinal system, and skin.[1] Due to their size, these particles can readily penetrate the body and cells through various

[1] Marambio-Jones C and MV Hoek E. A review of the antibacterial effects of silver nanomaterials and potential implications for human health and the environment. *J Nanopart Res*. 2010;12:1531-1551. Available at: http://www.phy.pmf.unizg.hr/~dpajic/buksa/nanomaterijali/Misak_silverantibacterialimplicationshumanhealthenvironmentJNanopartRes121531.pdf.

routes.[2] Preliminary research with laboratory rats has found that silver nanoparticles can traverse into the brain, and can induce neuronal degeneration and necrosis (death of cells or tissue) by accumulating in the brain over a long period of time.[3] Other potential harmful effects include the generation of dangerous radicals that injure cells by attacking DNA, proteins and membranes.[4] A large number of in-vitro studies indicate that silver nanoparticles are toxic to mammalian cells derived from skin, liver, lung, brain, vascular system and reproductive organs.[5] However, little has been done to evaluate these interactions and their health impacts on humans.

Silver Nanoparticles in the Environment

Samuel Luoma, Ph.D., at the John Muir Institute of the Environment at the University of California, Davis, in his report called "Silver Nanotechnologies and the Environment: Old Problems or new Challenges?," states that nearly one-third of nano silver products on the market in September 2007 had the potential to disperse silver or silver nanoparticles into the environment. Cosmetics, personal grooming products, and household cleaning products, among others, disperse nanoparticles into wastewaters when washed down the drain. Textiles and clothing imbedded with nanoparticles, when laundered, release these particles into the wash cycle and they eventually make their way into waste and surface waters.[6] A 2008 study found that socks impregnated with silver nanoparticles to keep them microbe and odor free, release these particles when washed. Some lost the bulk of their nano silver after two to four washings.[7]

Silver nanoparticles have been found in sewage sludge at water treatment plants, indicating that these particles have indeed entered the water system. Microbial populations, especially those in waste water treatment plants (WWTPs), are also vulnerable to silver nanoparticles contamination. Silver nanoparticles inhibit the growth of bacteria and other

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[2] Panyala N, Peña-Méndez EM, and Havel J. Silver or silver nanoparticles: a hazardous threat to the environment and human health. *Journal of Applied Biomedicine*. 2008;6:117-129.

[3] Tang J, et al. Influence of silver nanoparticles on neurons and blood-brain barrier via subcutaneous injection in rats. *Applied Surface Science*. 2008;255:502-504. Available at: http://www.sciencedirect.com/science/article/pii/S0169433208015092.

[4] Flower NAL, et al. Characterization of synthesized silver nanoparticles and assessment of genotoxic potentials using the alkaline comet assay. *Mutation Research/Genetic Toxicology and Environmental Mutagenisis*. 2012;742:61-65. Available at: http://www.sciencedirect.com/science/article/pii/S1383571811003561.

[5] Ahamed M, AlSalhi MS, Siddiqui MKJ. Silver nanoparticle applications and human health. *Clinica Chimica Acta*. 2010;411:1841-1848. Available at: http://www.sciencedirect.com/science/article/pii/S0009898110005139.

[6] Luoma SN. Silver Nanotechnologies and the Environment: Old Problems or New Challenges?. Woodrow Wilson International Center for Scholars. 2008. Available at: http://wwwrcamnl.wr.usgs.gov/tracel/references/pdf/Luoma%202008_pen_15.pdf.

[7] Benn TM and Westerhoff P. Nanoparticle Silver Released into Water from Commercially Available Sock Fabrics. *Environmental Science and Technology*. 2008;42:4133-4139. Available at: http://www.researchgate.net/profile/Paul_Westerhoff/publication/5263643_Nanoparticle_silver_released_into_water_from_commercially_available_sock_fabrics/links/0a85e53358e403b3ff000000.pdf.

microorganisms, essential to the waste water treatments process.[8,9] The environmental risks are not clear, however. Many particles may aggregate or associate with other ions or materials in the environment and deposit into sediments and soils. Some, however, can remain in surface waters, where they can be absorbed and/or ingested by aquatic organisms. Nanoparticles may also enter the bodies of shellfish, fish and even aquatic plants. Their ability to be easily taken into the bodies of organisms indirectly exposes humans and other higher mammals to nanoparticles absorbed by these species, especially through the ingestion of filter feeding organisms such as mollusks.[10]

A major challenge for this new technology is the development of protocol to detect and investigate the behavior of nanoparticles in the environment and how they impact biological systems. It is unclear how many silver nanoparticles have been released into the environment, and it is imperative that the environmental risks of these particles be properly assessed in order to protect human and environmental health.

In summary, there are serious unanswered questions related to current exposure to nano silver, a high degree of uncertainty, documented interactions in the environment, and known adverse impacts on health and the environment. Given this, we urge EPA to reject all applications for product and active ingredient registrations for any new uses of nano silver materials and any new nanoscale active ingredients. We request the agency use the same thinking it used in setting a moratorium on any new uses or registrations of neonicotinoid insecticides on April 3, 2015. We believe that the principle associated with that action applies to the continued and expanded uses of nano silver –that until EPA has evaluated the issues raised in this comment and other public comments and, to use EPA's words, "*appropriate risk assessments completed, it is unlikely to be in a position to determine that such uses would avoid unreasonable adverse effects on the environment.*"

Thank you for your attention to our comments and request.

Sincerely,

Jay Feldman
Executive Director

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[8] Kim B, et al. Discovery and Characterization of Silver Sulfide Nanoparticles in Final Sewage Sludge Products. *Environmental Science and Technology*. 2010;44:7509-7514. Available at: http://pubs.acs.org/doi/abs/10.1021/es101565j.

[9] Choi O, et al. The inhibitory effects of silver nanoparticles, silver ions, and silver chloride colloids on microbial growth. *Water Research*. 2008;42:3066-3074. Available at: http://www.sciencedirect.com/science/article/pii/S0043135408000961.

[10] Moore MN. Do nanoparticles present ecotoxicological risks for the health of the aquatic environment?. *Environmental International*. 2006;32:967-976. Available at: http://www.sciencedirect.com/science/article/pii/S0160412006000857.