

National Aeronautics and
Space Administration
Ames Research Center
Moffett Field, CA 94035-1000



December 9, 2009

Reply to Attn of: **JQ: 237-14**

Dr. Jeffrey Wong
Chief Scientist
California Department of Toxic Substances Control
PO Box 806
Sacramento, CA 95812-0806

Subject: Chemical Information Call-In on Carbon Nanotubes

Dear Dr. Wong:

Thank you for the opportunity for NASA Ames Research Center (NASA Ames) to respond to the California Department of Toxic Substance Control (DTSC) Chemical Information Call-In on Carbon Nanotubes. Listed below are the DTSC questions in italics followed by the NASA Ames response.

The NASA Ames Environmental Management Division and Health and Safety Division developed an internal questionnaire based on the DTSC questions as a means to gather information from the Principal Investigators (PI) at NASA Ames.

1. What is the value chain for your company? In what products are your carbon nanotubes used by others? In what quantities? Who are your major customers?

NASA Ames is a Federal facility that conducts very small-scale research and development (R&D) of carbon nanotubes under the R&D exemption of the Federal Toxic Substances Control Act. NASA Ames is not engaged in the sale or distribution of nanotubes.

Although the PIs at NASA Ames do not manufacture the nanotubes for sale or distribution and no customers currently exist for the nanotubes produced during R&D at NASA Ames, potential products resulting from the research could include heat shields or materials that could be used to fabricate heat shields. Other potential applications include wiring, electron sources, microelectronics, batteries, adhesives, and thermal interface materials.

2. What sampling, detection and measurement methods are you using to monitor the presence of your chemical in the workplace and the environment? Provide a full description of all required sampling, detection, measurement and verification methodologies. Provide full QA/QC protocol.

Because NASA Ames is involved in very small scale R&D of carbon nanotubes, no monitoring of the workplace specifically for nanotubes occurs. Instead, safe work practices are in place where carbon nanotubes are maintained in tightly closed containers. Any spill of carbon nanotubes would be remediated using a wet technique to capture that entire spill on surfaces.

NASA Ames has not found anything on the market that can measure carbon nanomaterial specifically. Thus, NASA Ames has purchased a Condensation Particle Counter and has used it to compare background particle concentrations with concentrations during carbon nanotube work.

3. What is your knowledge about the current and projected presence of your chemical in the environment that results from manufacturing, distribution, use and end of life disposal?

NASA Ames does not manufacture carbon nanotubes for sale or distribution. The carbon nanotubes used on site in R&D are disposed of as hazardous waste. The PIs in the laboratories use good laboratory practices to protect themselves and the environment from carbon nanotube contamination. The entrances to the labs have sticky mats in place that help keep the lab floors clean and also prevent nanomaterials from leaving the labs via personnel. Personnel also use disposable laboratory coats and the coats are restricted to the nanomaterial labs, ensuring that nanomaterials do not inadvertently leave the laboratory on clothing.

After 40 hours of use, the laboratory coats are disposed of as non-RCRA hazardous waste. However, if lab coats are soiled by hazardous materials associated with the nanotube R&D or otherwise, the lab coats are disposed of immediately as RCRA hazardous waste. Other carbon nanotube contaminated materials such as gloves, wipes, glassware, and plastic are also disposed of as non-RCRA hazardous waste at the CWM Kettleman Hills disposal facility. Carbon nanotubes contained in flammable solutions are labpacked and sent for incineration at an approved Hazardous Waste Treatment, Storage, and Disposal (TSD) facility.

Further, all nanomaterial use is conducted under a fume hood or a glove box. Management is considering options for adding an air filter in the fume hood exhaust to ensure that nanomaterials do not leave the laboratory through the exhaust stack.

4. *What is your knowledge about the safety of your chemical in terms of occupational safety, public health and the environment?*

NASA Ames is aware that carbon nanotubes are small enough to enter the body via dermal exposure, inhalation and/or ingestion.

5. *What methods are you using to protect workers in the research, development and manufacturing environment?*

Personnel at NASA Ames use safety precautions in handling carbon nanotubes. The nanotubes are maintained in tightly closed screw cap containers. Nanomaterials stored in a liquid are also stored in a container with individual sections to ensure that the material is stored upright and that secondary containment is provided. When handling carbon nanotubes, the users use personal protective equipment (PPE). Personnel wear nitrile gloves, safety glasses and laboratory coats. Laboratory coats are either Tyvek® or a generic brand. Personnel are required to use safety glasses; however, when using hydrofluoric acid (HF), they are required to use goggles and face shields. The gloves and lab coats provide dermal protection. The gloves also help to contain the spread of carbon nanotubes. When handling loose carbon nanotubes, personnel perform all work under a fume hood or a glove box.

NASA Ames has established a Nanomaterial Safety Committee. Researchers involved in nanotube R&D attend meetings to discuss and learn the requirements for safely storing and using nanotubes at NASA Ames. NASA has also begun adopting NIOSH guidelines from the recent publication of "Approaches to Safe Nanotechnology" for controlling exposure to carbon nanotubes and engineered nanomaterials.

NASA Ames maintains an Environmental Management System that is ISO 14001-equivalent. In addition to having written policies and procedures and providing training and outreach, the hazardous material/hazardous waste management program is subject to routine inspections by regulatory agencies and 3-year audits by a NASA Headquarters-led environmental audit team. Further, NASA Ames is one of only four Federal facilities to receive the Occupational Health and Safety Administration (OSHA) Voluntary Protection Program (VPP) STAR certification. Under the VPP, NASA Ames Health and Safety Division audits the Center each year and an OSHA-led team conducts a VPP Star re-certification audit every 3 years.

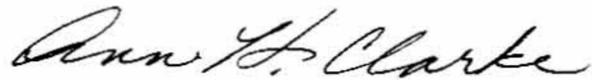
6. *When released, does your material constitute a hazardous waste under California Health and Safety Code provisions? Are discarded off spec materials a hazardous waste? Once discarded are the carbon nanotubes you produce a hazardous waste? What are your waste handling practices for carbon nanotubes?*

NASA Ames treats discarded carbon nanotubes and all discarded off spec materials as hazardous waste under California Health and Safety Code provisions. See also responses

to above questions. PIs containerize and label carbon nanotube waste, then submit a form to the on-site support services contractor supporting the NASA Ames hazardous waste management program. HAZWOPER-trained technicians pick up the waste and take it directly to an on-site 90-day storage area and arrange for disposal at an approved TSD facility. NASA Ames Environmental Management Division staff sign manifests and audit disposal facilities.

If you have any questions regarding this letter, please contact me at 650-604-2350.

Sincerely,

A handwritten signature in cursive script that reads "Ann H. Clarke".

Dr. Ann H. Clarke
Chief, Environmental Management Division