C36 Is Amorphous Silica Gel Non-Toxic? Differences in Dose: Exposure Route and Physical Form

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After attending this presentation, attendees will have a better understanding of how the toxicity of a substance changes with route of exposure and physical form. Dr. Smith will use two case studies involving amorphous silica gel ("ASG") or silica aerogel ("SA") to illustrate how changes in the route of exposure and a material's physical form can alter its ability to cause adverse health effects.

This presentation will impact the forensic community and/or humanity by demonstrating how information relating to exposure route and an agents physical form can determine the type and severity of toxicological effects observed in exposed people. Understanding these concepts is essential for regulators involved in the evaluation of agents for the protection of human and environmental health, interpretation of regulations concerning pesticide use, and in the use of expert witness testimony for effective risk communication. This presentation provides a basis for understanding these concepts, applying them to the evaluation of compound toxicity, and for use in risk communication.

This paper has three objectives: (1) to define the qualities of dose that makes a substance a poison; (2) to illustrate how toxicity of ASG is determined by route of exposure and physical form; and (3) to illustrate how such dose information can be abused in legal proceedings.

Toxicologists often say that "the dose makes the poison." This implies that all substances are toxic and that it is the magnitude of the dose that determines whether a substance is either safe or toxic. Although true, there is much more information required about the "dose" of a substance that determines whether a substance is a poison than simply its magnitude.

In the last 30 years of cleaning up hazardous waste sites, federal and state regulators and even some toxicologists have confused the amount of a substance in environmental media with the dose. By definition, dose is the amount of a substance that reaches the organ ("target organ") where the material has the toxic effect of interest. Consequently, dose is often adjusted to reflect the fraction of the substance in soil or water that is able to enter the body (i.e., bioavailability) and reach the target organ of interest. For example, generally less than 25 percent of the arsenic found in soil is absorbed form the gastrointestinal tract after ingestion. Furthermore, it is well recognized that the amount of a substance that is able to reach the target organ differs with different routes of exposure (i.e., ingestion, dermal contact, inhalation, and injection). For example, where nearly the entire injected dose of barium reaches the target organ, less than 10 percent is absorbed through the skin. Finally, the physical form of a substance can have as much to do with its relative bioavailability and toxicity as does the magnitude of its dose. For example: although the U.S. EPA assumes that all arsenic compounds have toxicity equivalent to the mass of arsenic in those compounds, their toxicity differs with respect to their relative solubility. In another example, only asbestos fibers of a certain size are associated with the development of cancer in the lung. This presentation discusses how the route of exposure and the physical form of ASG can combine to result in adverse health effects.

ASG is sold to end users as a non-toxic "natural" substance with a variety of uses, including use as a food product additive, in paints, cosmetics and in pharmaceuticals, desiccant, and pesticide. For the vast majority of these uses ASG is essentially without toxic effect to the end user, but for at least one specific use, ASG poses a health hazard to people. Although silica is a "natural" element in the environment that is commonly associated with beach sand, soils, and rock, ASG is a manmade product that is radically different from the many silica products we are familiar with (i.e., window glass, ceramics, and silica wafers used in the electronic industry). Toxicologists have long recognized the seriousness of the health consequences associated with crystalline silica exposure; silicosis. Because chronic exposure to ASG exposure does not result in silicosis, many business concerns have labeled it "non-toxic."

Dr. Smith explores ASG toxicity under different exposure routes and physical forms commonly used in product formulations. Dr. Smith uses two case histories to illustrate how dose information is abused in legal proceedings and proposes several approaches to educating jurors to minimize dose information abuse.

Amorphous Silica Gel, Silica Aerogel, Silica

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