

4. PRODUCTION, IMPORT, USE, AND DISPOSAL

4. PRODUCTION

Diisopropyl methylphosphonate is an organophosphate compound that was first produced in the United States as a by-product of the manufacture of the nerve gas isopropyl methylphosphonofluoridate (GB, or Sarin) (ATSDR 1996; EPA 1989; Robson 1977, 1981). It is not a nerve gas and is not a metabolite or degradation product (Roberts et al. 1995). Diisopropyl methylphosphonate constitutes approximately 2-3% of the crude GB product, but it is neither a metabolite nor a degradation product of GB (EPA 1989; Rosenblatt et al. 1975b). Diisopropyl methylphosphonate is not normally produced except for its use in research. One method of producing diisopropyl methylphosphonate is to combine triisopropyl phosphite and methyl iodide. The mixture is then boiled, refluxed, and distilled, yielding diisopropyl methylphosphonate and isopropyl iodide (Ford-Moore and Perry 1951). Diisopropyl methylphosphonate may also be prepared from sodium isopropyl methylphosphonate by a reaction at 270° C, but a portion of the resulting diisopropyl methylphosphonate is converted to trimethylphosphine oxide at this temperature (EPA 1989).

The only actual production of the diisopropyl methylphosphonate-containing GB nerve gas occurred during the years 1953-1957 at the RMA near Denver, Colorado. Beginning in 1957, the RMA became a storage site for unused chemical warfare agents. Then, beginning in 1973, the GB manufacturing facility was used to detoxify the stored GB nerve agent (Robson 1977, 1981). Diisopropyl methylphosphonate and other industrial effluents have been released at the RMA as a result of both the manufacturing and detoxification activities conducted at the site (ATSDR 1996; Robson 1977, 1981). Actual volumes of diisopropyl methylphosphonate at the RMA from GB manufacture and detoxification are unknown. No chemical agents are currently stored at the RMA (EPA 1989). Diisopropyl methylphosphonate is not known to occur naturally in the environment, and it does not appear to have any current uses that would result in its further production (EPA 1989).

4.2 IMPORT/EXPORT

No information could be found regarding import or export volumes of diisopropyl methylphosphonate.

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4.3 USE

There are no known commercial uses of diisopropyl methylphosphonate. The military has used diisopropyl methylphosphonate as a chemical simulant in training and in experiments to determine the toxicity, persistence, and fate of GB nerve gas in the environment (Van Voris et al. 1987) and the movement and permeation of GB nerve gas through porous media and protective clothing (Jenkins et al. 1994; Pal et al. 1993; Vo-Dinh and Pal 1992). Simulants such as diisopropyl methylphosphonate were used because they possess some properties which resemble those of more hazardous compounds. The simulants can be used to mimic and study specific attributes of the more hazardous compounds when training personnel and developing chemical defense material (Van Voris et al. 1987). Because diisopropyl methylphosphonate does not appear to be a cholinesterase inhibitor, it was used as a simulant for the more toxic GB (Sarin) nerve agent. No information was found concerning the approximate amounts of diisopropyl methylphosphonate used as a simulant.

4.4 DISPOSAL

The Department of Defense Authorization Act of 1986 (Public Law 99-145) directed the Secretary of Defense to destroy all lethal unitary chemical munitions and agents by September 30, 1994, including organophosphate nerve agents such as GB. The act was amended in 1988 (Public Law 100-456) to allow for complete disposal of chemical munitions by April 1997.

One method for disposing of diisopropyl methylphosphonate is microwave decomposition, in which nearly 100% decomposition of diisopropyl methylphosphonate is obtained in a microwave plasma discharge (Bailin et al. 1975). Another method for disposing of diisopropyl methylphosphonate is ultraviolet and infrared laser-induced photodestruction, resulting in the production of simple hydrocarbon gases in a phosphorous-bearing acid (Radziemski 1981). Chemical oxidation coupled with ultraviolet radiation catalyzation can be used to successfully remove diisopropyl methylphosphonate from industrial effluents (Zappi et al. 1990). Granular activated carbon has been shown to significantly reduce the concentration of diisopropyl methylphosphonate in contaminated groundwater (Calgon 1977).

Diisopropyl methylphosphonate has not been shown to be amenable to biodegradation. Little if any degradation by indigenous bacteria occurred in soil "dosed" with radiolabelled diisopropyl methylphosphonate (Williams et al. 1989). Biodegradation by aquatic microorganisms has been shown to be

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equally ineffective (Spangord et al. 1979; Van Voris et al. 1987), rendering it inappropriate as a means for the disposal of diisopropyl methylphosphonate.

