

5. PRODUCTION, IMPORT/EXPORT, USE, AND DISPOSAL

5.1 PRODUCTION

Table 5-1 lists the facilities in each state that process hexachlorocyclohexane, the intended use, and the range of maximum amounts of hexachlorocyclohexane that are stored on site. These data only pertain to γ -HCH (lindane) and reflect the amounts that are formulated into various pesticide products, pharmaceuticals (shampoos or lotions to treat lice), or seed treatments. The data listed in Table 5-1 are derived from the Toxics Release Inventory (TRI02 2004). Only certain types of facilities were required to report. Therefore, this is not an exhaustive list.

HCH does not occur as a natural substance. The manufacturing of technical-grade HCH involves the photochlorination of benzene, which yields an isomeric mixture consisting of α -HCH, β -HCH, γ -HCH, δ -HCH, ϵ -HCH, and inerts (IARC 1979); this reaction can be started by free-radical initiators such as visual or ultraviolet light, X-rays, or γ -rays (Kirk-Othmer 1985). Treatment with methanol or acetic acid, followed by fractional crystallization, concentrates γ -HCH to the 99.9% required in the technical-grade of γ -HCH (IARC 1979); nitric acid is used to remove odor (SRI 1987). None of the isomers or technical-grade HCH are currently produced in the United States. The production of γ -HCH exceeded 2.27×10^6 g in 1976 (HSDB 2003); commercial γ -HCH production in the United States reportedly ended in that year (EPA 1989b). However, the *Directory of Chemical Producers for 1987 and 1988* lists one producer of γ -HCH, Drexel Chemical Company (SRI 1987, 1988); subsequent volumes (1989–1991) give no listings of γ -HCH producers.

γ -HCH is available in emulsifiable and flowable concentrates, soluble concentrates/liquids, wettable powders, dusts, ready-to-use liquids, pressurized liquids and impregnated materials, oil base and aerosol sprays, granules, and as a smoke generator (Berg 1988; EPA 1985a). γ -HCH is sold separately or in combination with fungicides, fertilizers, other insecticides, or wood preservatives (Hayes 1982).

5.2 IMPORT/EXPORT

γ -HCH is not produced in the United States. It is imported from France, Germany, Spain, Japan, and China (EPA 1985a). Once in the United States, it can be formulated in various pesticide products and exported. The U.S. imports of γ -HCH declined from 1.52×10^5 kg in 1977 to 8.53×10^4 kg in 1982 (HSDB

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Table 5-1. Facilities that Produce, Process, or Use Hexachlorocyclohexane

State ^a	Number of facilities	Minimum amount on site in pounds ^b	Maximum amount on site in pounds ^b	Activities and uses ^c
AL	1	10,000	99,999	2, 4
AR	2	1,000	99,999	12
CO	1	10,000	99,999	7
FL	2	No data	99,999	2, 4, 7
GA	9	1,000	999,999	2, 3, 4, 7, 9
ID	5	10,000	999,999	2, 3, 7
IL	2	1,000	99,999	7, 12
IN	1	100,000	999,999	12
KS	1	1,000	9,999	7
KY	2	10,000	99,999	7, 12
MO	3	10,000	999,999	2, 3, 7
MS	2	No data	999,999	2, 3, 7, 12
ND	7	10,000	999,999	1, 2, 3, 4, 7, 9, 10, 11
NE	4	1,000	999,999	7, 12
NJ	3	100	99,999	9, 12
OH	2	100	9,999	12
OR	1	100	999	12
SC	1	10,000	99,999	12
TX	6	1,000	999,999	2, 5, 7, 8, 12

Source: TRI02 2004 (Data are from 2002)

^aPost office state abbreviations used

^bAmounts on site reported by facilities in each state

^cActivities/Uses:

- | | | |
|--------------------------|--------------------------|-----------------------------|
| 1. Produce | 6. Impurity | 11. Chemical Processing Aid |
| 2. Import | 7. Reactant | 12. Manufacturing Aid |
| 3. Onsite use/processing | 8. Formulation Component | 13. Ancillary/Other Uses |
| 4. Sale/Distribution | 9. Article Component | 14. Process Impurity |
| 5. Byproduct | 10. Repackaging | |

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2003). In 2002, it was estimated that 90 metric tons (9.0×10^4 kg) of γ -HCH were imported into the United States (Hauzenberger et al. 2002). Facilities that import γ -HCH for use as a formulation component are shown in Table 5-1. Up until 2001, it was estimated that 500 metric tons of γ -HCH containing pesticide products were exported annually by the United States (primarily to Canada) (Hauzenberger et al. 2002). That export volume dropped to 25 metric tons in 2001 and is expected to decline significantly as the use of γ -HCH decreases in other countries.

5.3 USE

γ -HCH was initially registered by the USDA (U.S. Department of Agriculture) in the 1940s and over the years, was approved for use on a wide variety of fruit and vegetable crops (including seed treatment), tobacco, greenhouse vegetables and ornamentals, forestry (including Christmas tree plantations), farm animal premises, and other uses. In February 1977, EPA issued a notice of Rebuttal Presumption Against Registration (RPAR), now called a Special Review, and continued registration of pesticide products containing γ -HCH. EPA took this action in response to indications of γ -HCH's potential carcinogenic effect, possible developmental and reproductive effects, possible blood dyscrasias, and delayed toxic effects, as well as its acute toxic effects seen in aquatic wildlife (IARC 1979). In October of 1983, EPA issued a "Notice of Intent to Cancel Pesticide Products Containing γ -HCH." The contentions concerning developmental and reproductive effects were successfully challenged by industry. EPA no longer permits the use of γ -HCH for purposes involving direct aerial application (EPA 1985b). The notice restricted certain applications of γ -HCH on livestock, structures, and domestic pets to certified applicators or persons under their direct supervision (EPA 1985b). In November 1993, EPA issued a "Notice of Receipt of a Request for Amendments to Delete Uses" for several formulations of γ -HCH powder, 99.5% technical-grade HCH, and dust concentrate, which would delete from the pesticide label most uses of γ -HCH for agricultural crops and use on animals and humans (EPA 1993). According to the EPA's most recent Registration Eligibility Decision (RED), the only current food/feed use of γ -HCH that is being supported for re-registration is seed treatment on barley, corn, oats, rye, sorghum, and wheat (EPA 2002b). Since the 1998 and 1999 use deletions, the registrants are no longer interested in supporting the seed treatment use on broccoli, Brussel sprouts, celery, cabbage, cauliflower, collards, kale, kohlrabi, mustard greens, lettuce, radishes, spinach, and Swiss Chard (EPA 2002b).

γ -HCH is also available, and regulated by the U.S. Food and Drug Administration (FDA), for the pharmaceutical treatment of scabies and head lice (EPA 2002b). A 1% γ -HCH lotion is available for the treatment of scabies, and a 1% shampoo is available for the treatment of head lice. Both uses have been

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on the market since 1947, but were labeled as a second line therapy in 1995 after a review by the FDA. The FDA is revising the label for the treatment of scabies, which would effectively prohibit its use on infants and children weighing less than 60 kg (EPA 2002b). In the past, γ -HCH was used in veterinary products to control mites and other pests, but recent data suggest that no products are currently registered in the United States for this use (Hauzenberger et al. 2002). Based on EPA estimates from 1996 to 2001, about 233,000 pounds of γ -HCH are used annually as a seed treatment (EPA 2002b).

5.4 DISPOSAL

Hexachlorocyclohexane is listed as a toxic substance under Section 313 of the Emergency Planning and Community Right to Know Act (EPCRA) under Title III of the Superfund Amendments and Reauthorization Act (SARA) (EPA 1995). Disposal of wastes containing hexachlorocyclohexane is controlled by a number of federal regulations (see Chapter 8).

While current disposal techniques may be adequate, new methods provide increased efficiency and quality of disposal at a greatly reduced cost. The use of demulsification, sorption, and filtration in combination with chemical and biological degradation of pesticide waste waters is being examined. This process is divided into two phases. First, demulsification agents (lignocellulosic materials, peat moss, wood products, etc.) are utilized in the removal of solubilized pesticides. In the second phase II, the solid matter (pesticide-saturated sorbents and suspended particulates) is physically separated from the aqueous material through a variety of filtration techniques. The aqueous phase is either recycled or discarded, and the solid phase, in which the concentration of the pesticide is most significant, is further treated through composting (Mullins et al. 1992).

In order to facilitate the composting process, it is important to use sorption agents that provide a beneficial environment for the pesticide-degrading microorganisms. Peat moss, ground pine bark mulch, and steam-exploded wood fibers are excellent demulsifiers because they are highly sorbent, readily available, and inexpensive. They also provide the nutrients required by the degrading microorganisms, although the peat moss media require some carbohydrate enrichment. The solid waste can be either directly metabolized or co-metabolized by multiple species of microbes. The number of compost cycles, and therefore the amount of energy input required, depends on the pesticide concentration and on how easily the pesticide can be biodegraded. In preliminary studies by Mullins and coworkers, this process has reduced the concentration of γ -HCH in waste materials significantly, with <1% of the original pesticide remaining after 24-hour incubation (Mullins et al. 1992).

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Additional work is required, but the benefits of this disposal technique are clear. It is cost effective, reliable, and can be adapted to the variety of disposal challenges presented by the multitude of pesticides that are currently used. The use of microbial consortia ensures that each pesticide will be degraded rapidly. This method can also be used on pesticide mixtures (Mullins et al. 1992).

Disposal methods are currently subject to significant revision by EPA (HSDB 1997).