About CSIR-NEERI

CSIR-NEERI is endorsed as Stockholm Convention Regional Centre (SCRC) on Persistent Organic Pollutants (POPs) for Asia Region at COP-5 meeting held during 25-29th April 2011 at Geneva. SCRC is serving different parties/countries in the Asia region to help them in their capacity building and transfer of technologies related to POPs and new POPs. Besides India, CSIR-NEERI is serving ten countries of Asia region viz. Bangladesh, Maldives, Mongolia, Myanmar, Nepal, Philippines, Thailand, Sri Lanka, UAE and Vietnam. The goals of the SCRC is to provide technical assistance for building capacities of the parties of the Asia region in relation to monitoring and assessment of POPs in the environment, transfer of technologies, raise awareness and promote identification and environmentally sound management (ESM) of POPs and POPs contaminated sites in the region. The Centre is also assisting the parties of Asia region in fulfilling their obligations of the Stockholm Convention.

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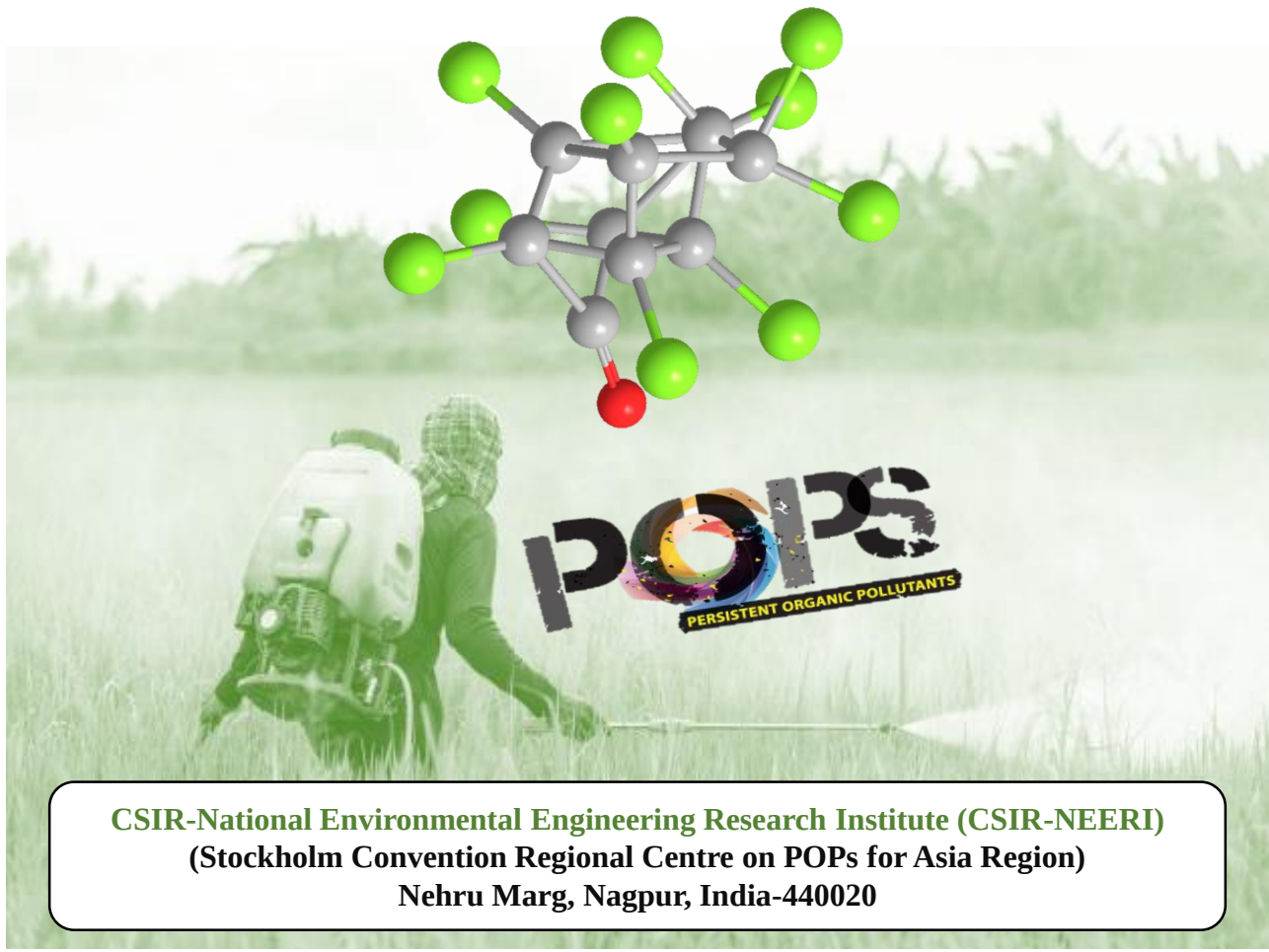
Chlordecone



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1. What is Chlordecone?

- Chlordecone is also known as Kepone.
- Odourless, colorless crystalline solid.
- Chemically related to Mirex.
- Diluted technical product of chlordecone is Kelevan, which is used as a pesticide.
- Used as an insecticide/fungicide on bananas, non-bearing citrus trees, tobacco and in lawns and flowers.
- Used as fungicide against apple scab and powdery mildew and to control the Colorado potato beetle, rust mite on non-bearing citrus, and potato and tobacco wireworm on gladioli and other plants.

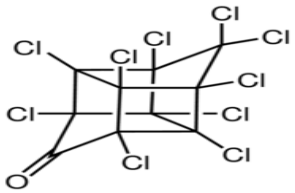


Fig. Structure of Chlordecone

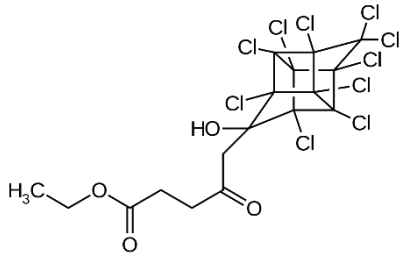
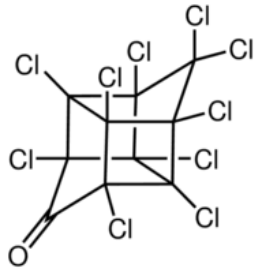


Fig. Structure of Kelevan

2. What are the characteristics of Chlordecone?

- CAS number : 143-50-0
- Chemical formula (general) : $C_{10}Cl_{10}O$
- IUPAC Name :1,2,3,4,6,7,8,9,10,10-decachloropentacyclo [5.3.0.0^{2,6}.0^{3,9}.0^{4,8}] decan-5-one
- Description : Colourless Crystalline Solid
- Molecular mass : 490.609 g/mol
- Boiling point : Sublimes
- Melting point : 350.0 °C
- Density : 1.64 g/cm³ at 25 °C
- Solubility : less than 1 mg/mL at 22 °F
- Vapour pressure : 2.25 × 10^{-7} mm Hg
- Stability : Stable under recommended storage conditions
- Log K_{ow} : 5.41



Source- PubChem; www.pubchem.ncbi.nlm.nih.gov/compound/Kepone

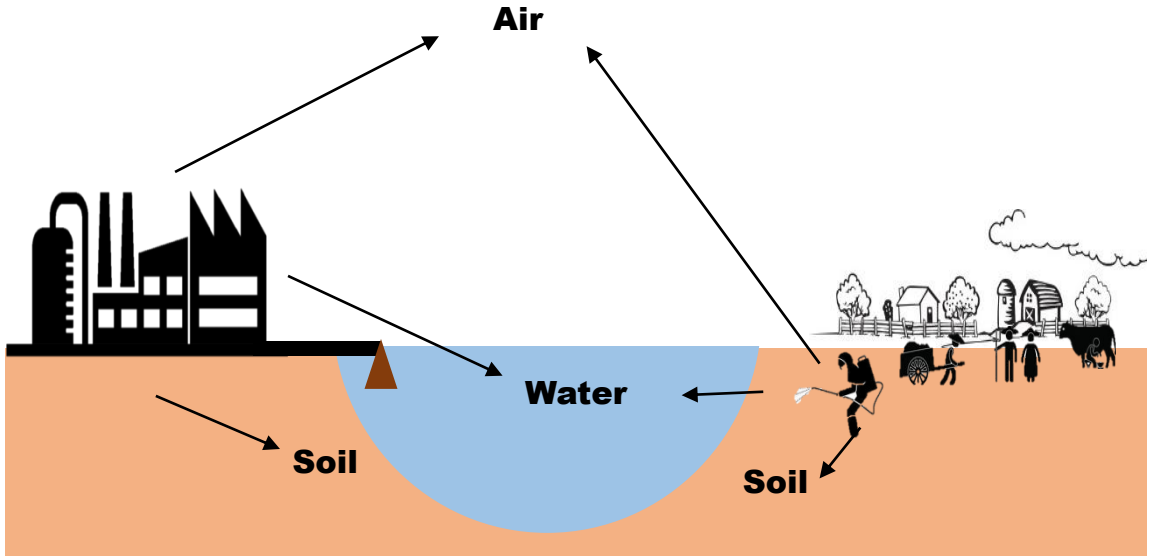
3. What are the applications of Chlordecone?

- Chlordecone is a synthetic chlorinated organic compound, which is mainly been used as an agricultural insecticide, miticide and fungicide.
- The chemical has been used extensively in the tropics for the control of banana root borer (Langford, 1978). It is identified as an effective insecticide against leaf-cutting insects, but less effective against sucking insects (Information Canada, 1973).

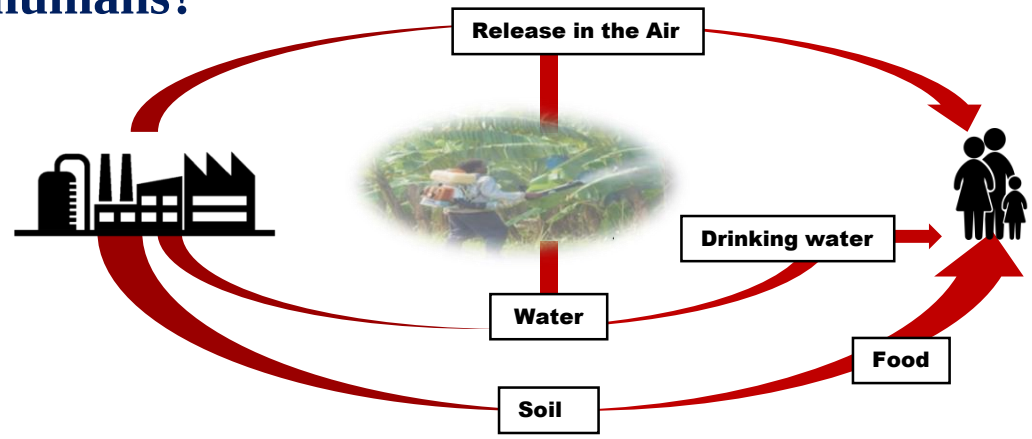
Chlordecone used as an insecticide
Image Source: bioenergyigert.wordpress.com

4. What are the sources for release in the environment?

- Given the specific pesticidal uses of Chlordecone, it can be expected that all amount manufactured are ultimately released to the environment (UNEP/POPs/POPRC.3/20/Add.10)
- Major sources of release of Chlordecone in environment is during manufacturing and storage activities (US ATSDR, 1995)
- One of the major sources of Chlordecone release in the environment is through its application as an agricultural pesticide.

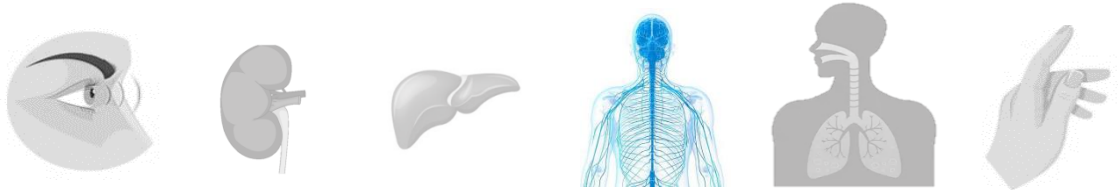


5. What are the possible routes of exposure to humans?



- Readily absorbed via
  - ❖Ingestion by animals and human beings
  - ❖Inhalation and dermal exposure
- Chemical once absorbed gets widely distributed in the body and accumulation majorly occurs in the liver.
- Target Organs: Eyes, skin, respiratory system, central nervous system, liver, kidneys, reproductive system
- Half-life in the body: Several months
- Excretion: Concentrated mainly in the bile
- Inhalation symptoms: Incoordination, headache, tremor, and weakness

Target organs by Chlordecone



6. Why Chlordecone is a chemical of concern ?

- Chlordecone exhibits significant hazard for aquatic ecosystems because of
  - Its stability and persistence in sediments
  - Bioaccumulation in food chains and
  - Acute and chronic toxicity for animals.

  The international agencies have classified it as a probable carcinogen as mentioned below:
  - ❖ EPA: Likely to be carcinogenic to humans.
  - ❖ IARC: Possibly carcinogenic to humans.

- EPA: Evidence of carcinogenicity:
  - ❖ In animals: sufficient
  - ❖ In humans: no adequate data

- Listed under the Annex A of Stockholm Convention (SC-4/12) which is a global treaty working for Elimination, Prohibition and Restrictions of Persistent Organic chemicals (POPs).

- Moreover, Chlordecone is very toxic to aquatic organisms, with the most sensitive group being the invertebrates.

7. What happens to Chlordecone when it enters the environment?

Chlordecone break down slowly in the environment, and they may stay for years in soil and water:

- Air
  - ❖ Chlordecone released to air will be in or on particles that eventually deposited to the ground.
  - ❖ It is expected to be broken down by the sunlight.
- Water
  - ❖ Solubility in water is low.
  - ❖ It will be broken down very slowly under anaerobic conditions.
  - ❖ It has high build-up potentials for fishes.
- Soil
  - ❖ It is not likely to move through the soil.
  - ❖ High affinity for soils and sediments.
  - ❖ Act as sinks.

8. What are the health effects of Chlordecone?

- Single exposure in several animal species have shown to cause severe tremors. Tremors reached a maximum within 2 – 3 days, then gradually subsided.
- Tremors were exacerbated by excitement.
- Acute toxic symptoms: Nervous symptoms, liver hypertrophy, induction of mixed-function oxidases, structural and ultrastructural changes in the liver, thyroid, adrenals, and testes.
- Interferes with reproduction.
- Damage to the central nervous system, liver, and kidney
- General symptoms are headache, anxiety, tremor, visual disturbance, ataxia, chest pain and skin erythema.
- Acute Health Effects:
  - ❖Paternal effects: Spermatogenesis (including genetic material, sperm morphology, motility, and count)
  - ❖Reproductive: Testes, epididymis, sperm duct
  - ❖Tremor
  - ❖Effect on the menstrual cycle.
  - ❖Adrenal cortex hypoplasia

- Chronic Health Effects:
  - ❖May be a carcinogen in humans since it has been shown to cause liver cancer in animals.

Reproductive Hazard

Human exposure

- ❖Damage to sperm, low sperm counts, and decreased sex drive
- ❖No data on reproductive toxicity are available for female workers.

Animals exposure

- ❖Includes sperm effects and testicular damage
- ❖Altered estrous cycling and impaired fertility/sterility.

Regulations

Environmental Protection Agency (EPA)

Comprehensive Environmental Response, Compensation, and Liability Act
Reportable quantity (RQ) = 1 lb.

Listed as a hazardous constituent of waste.

Food and Drug Administration (FDA)
Action levels for Chlordecone in fish, shellfish, and crabmeat range from 0.3 to 0.4 ppm.

(https://ntp.niehs.nih.gov/ntp/roc/content/profiles/kepone.pdf)

9. What is the Indian Scenario of Chlordecone?

- The Government of India notified the Regulation of Persistent Organic Pollutants Rule, 2018 (MoEF&CC, March, 2018), for regulating the manufacture, trade, use, import and export of seven chemicals that may be hazardous to human and environment. Chlordecone is included in this list.
- The data on Chlordecone in Indian context is very limited and scanty.
- Lack of sufficient data pertaining to Health and Occupational study in Indian context.

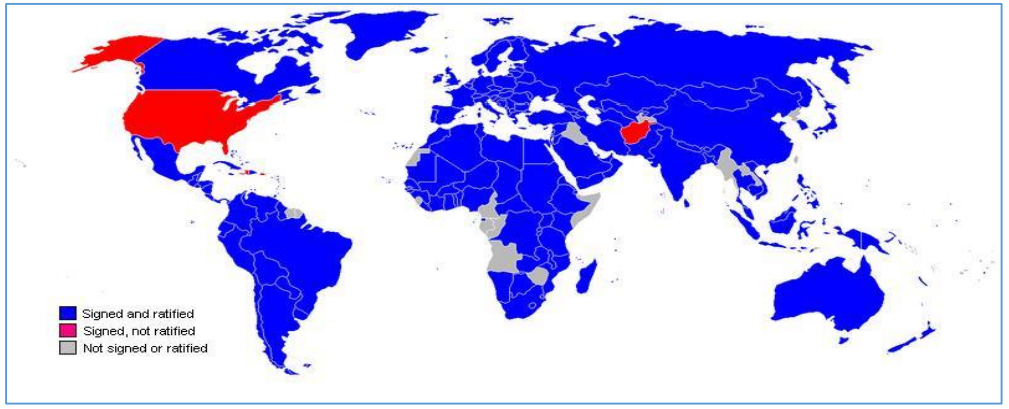
Guidelines for exposure to Chlordecone

National Institute for Occupational Safety and Health (NIOSH)
Recommended exposure limit (REL) = 0.001 mg/m^3
Listed as a potential occupational carcinogen.

(https://ntp.niehs.nih.gov/ntp/roc/content/profiles/kepone.pdf)

10. Stockholm Convention

- Stockholm Convention on POPs is a global treaty adopted on 22 May 2001 in Sweden and entered into force in 2004, with the aim to protect human health and environment from chemicals that remain intact in the environment for more extended period, become widely distributed geographically, accumulates in fatty tissues of humans and wildlife and have harmful effects on human health or on the environment.
- India ratified and became a member of this Convention on 13 January 2006. India is one among the nations which ratified the Stockholm Convention and took various important steps in the progress of the prohibition of POPs. (http://pib.nic.in/newsite/PrintRelease.aspx?relid=161203)
- The Government of India, with financial and technical support from the Global Environment Facility (GEF), initiated the NIP development process which involved the ground-level assessment of situation of POPs through inventorization, samples collection, analysis and interpretations (Government of India, 2011).



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