DICOFOL:
A CANDIDATE POP

Toxics Link
for a toxics-free world

Introduction

DICOFOL [2,2,2-trichloro-1,1-bis (4-chlorophenyl)ethanol] is an organochlorine pesticide that is chemically related to DDT which is an intermediate in its synthesis process. Dicofol comprises of two isomers: p,p'-dicofol and o,p'-dicofol. The typical isomer content in existing technical material is approximately 80% of p,p'-isomer and 20% of the o,p'-isomer.

Dicofol was introduced into the market by the US-based multinational company Rohm & Haas in 1957. It is generally used to control phytophagous mites on fruits, vines, ornamentals, vegetables, teas and field crops. Hindustan Insecticides Limited (India), Lainco (Spain) and Makhteshim Agan (Israel) are the current manufacturers of Dicofol. World Health Organization has classified Dicofol as a Level II, "moderately hazardous" pesticide.

ENVIRONMENTAL IMPACT OF DIOCFOL

Dicofol is structurally similar to DDT. It is cumulative & persistent in the environment and has a half-life of sixty days. Dicofol in soil is expected to bind to organic matter and is not likely to leach to groundwater, although there are reports of dicofol in groundwater. However, it breaks down in moist soils and in water or when exposed to ultraviolet light at pH levels above.

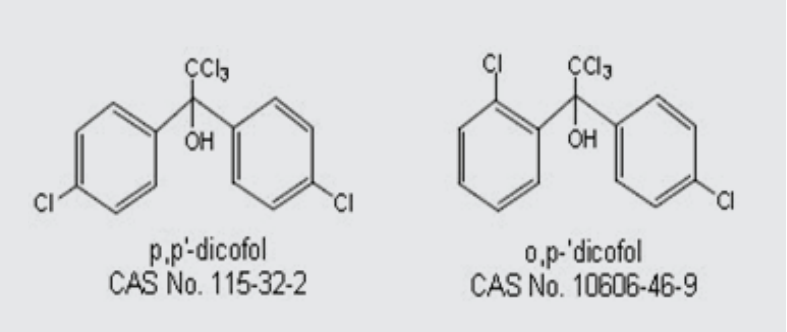


FIGURE 1 - Chemical Structure of Dicofol

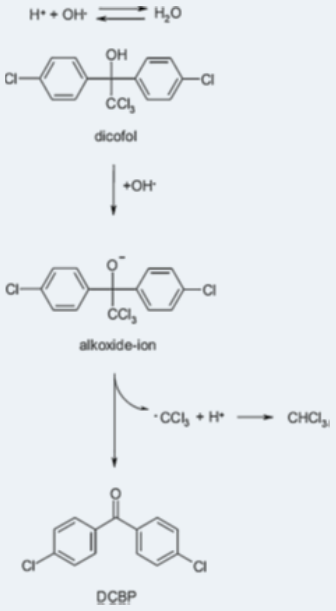
Due to its high absorption coefficient, dicofol is absorbed by sediments when released into open waters and can hydrolyse to dichlorobenzophenone (DCBP). Dicofol also accumulates in body fat.

The USEPA's PBT profiling model predicts dicofol to be persistent and bioaccumulative (USEPA, 2006). It is reported to be repro- toxic in wildlife and may reduce eggshell quality as well. Dicofol is also toxic to aquatic organisms with lethal/effective concentration, L(E) C50 values of 15-120 µg/l obtained by acute toxicity tests. Research shows that Dicofol interferes with the normal behavioral patterns in aquatic organisms.

DICOFOL DEGRADATION

Thiel *et al.* (2011) reported that dicofol, when adsorbed on waxy surfaces of fruits or leaves, might undergo light induced degradation. In the environment (soil, groundwater, rivers and fruits/leafy vegetables) mainly DCBP might be present as a result of its rapid formation from the parent dicofol. DCBP is a potent antiandrogen similar to p,p- dichlorodiphenylethene (DDE), metabolite of DDT. DCBP is proposed to contribute to the endocrine disrupting effects in wildlife populations.

Dicofol has been found to degrade under aqueous alkaline as well as under photolysis conditions into DCBP (Walsh and Hites, 1979; Reeve et al., 1980; Nome et al., 1981; Chen et al., 1984; Brown *et al*., 1986). It also has been reported to be metabolically transformed into DCBP in rats and mice (Brown et al., 1969; Brown and Casida, 1987).



HEALTH IMPACT

Research studies found that Dicofol can cause health impact in acute exposure. The WHO has classified Dicofol as a Class –II carcinogen.

As Dicofol has persistent characteristics, it can store in the fatty tissue of the humans and animals and can cause potential health risks. Intense activity or starvation may mobilize the chemical, resulting in the reappearance of toxic symptoms long after actual exposure.

Lessenger and Riley reported persistent cognitive and emotional difficulties in a young male exposed to a relatively high dose of Dicofol. Shimada and Yamauchi reported Dicofol as the most powerful inhibitor of T3 thyroid hormone uptake.

DICOFOL AS A POP IN STOCKHOLM CONVENTION

Dicofol meets the criteria for bioaccumulation due to its bioconcentration factor (BCF) > 5000 and also has a tendency of the long-range environmental transport. Research studies also indicate that Dicofol is highly toxic to aquatic organism. Due to these characteristics, it has been considered as a candidate POPs in Stockholm Convention. In 2008, on the basis of Risk Profile and Summary Report for Dicofol prepared by the Netherlands, the EU first nominated dicofol for listing as a POP under the Protocol.

ACUTE EFFECT

Ingestion and/or respiratory exposure

- nausea
- dizziness
- weakness
- vomiting

Dermal exposure

- skin irritation or a rash

Eye contact

- conjunctivitis

CHRONIC EFFECT

- convulsions
- coma
- death from respiratory failure

STOCKHOLM CONVENTION POPs REVIEW COMMITTEE (POPRC) MEETING 13-18 OCT. 2014

All Committee Members except India agreed that Dicofol met each of the four POPs screening requirements but the substance could not move forward due to India's political block in a consensus process. The inability to move forward on a substance that meets Convention criteria sets the stage for conflict at the next meeting.

India's main argument was that Dicofol is only persistent at low levels of pH, 5.5 or less, and that the majority of world's water bodies have a pH of around 7-8. However, evidence was provided of water bodies with natural pH's (i.e. not due to acidification) of 5.5 or less in the Arctic, North America, South America, Scandinavia, Scotland, Indonesia and Australia. India remained unmoved, insisting that the average pH was what mattered. India insisted that Dicofol has no adverse effects.

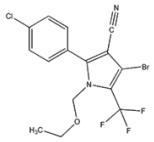
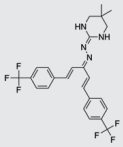
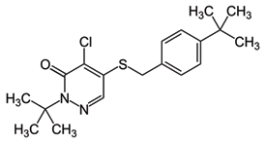
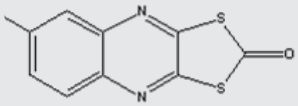
DICOFOL IN INDIA

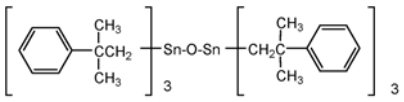
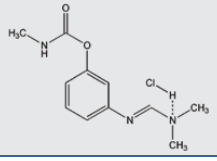
India is the world's largest producer of Dicofol and is produced by public company Hindustan Insecticide Limited. In India Dicofol is widely used as a pesticide on crops like tea, citrus, litchi, cotton, chilli, brinjal etc. Central Insecticidal Board has set the maximum residual limit (MRL) for Dicofol in fruits & vegetables.

Crop	MRL prescribed (mg/kg)
Fruits & vegetables	5.0
Tea	5.0
Chilli	1.0

Many countries have either banned or restricted the use of Dicofol and have opted for better alternatives. Currently there is no commercial production of Dicofol in the UNECE region. Worldwide production takes place in China, India and possibly in Brazil and Israel.

ALTERNATIVES TO DICOFOL

Compound	Chemical structure	Activity
Chlorfenapyr		Acaricide & Insecticide
Hydramethylnon		Insecticide, broad-spectrum fase effective acaricide
Pyridaben		Non-systematic acaricide & insecticide (specially for mites & whiteflies)
Oxythioquinox		Insecticide, Acaricide, fungicide & ovicide

Compound	Chemical structure	Activity
Fenbutatin-oxide		Acaricide
Formetanate hydrochloride		Acaricide & Insecticide

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