OPERATION OF THE PRIOR INFORMED
CONSENT PROCEDURE FOR BANNED
OR SEVERELY RESTRICTED CHEMICALS
IN INTERNATIONAL TRADE

DECISION GUIDANCE DOCUMENTS

Pentachlorophenol and its salts and esters

JOINT FAO/UNEP PROGRAMME
FOR THE OPERATION OF
PRIOR INFORMED CONSENT

United Nations Environment Programme

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Rome - Geneva 1991; amended 1996

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ABBREVIATIONS WHICH MAY BE USED IN THIS DOCUMENT

(N.B. : chemical elements and pesticides are not included in this list)

ADI	acceptable daily intake
ai	active ingredient
b.p.	boiling point
bw	body weight
^{o}C	degree Celsius (centigrade)
CCPR	Codex Committee on Pesticide Residues
DNA	Designated National Authority
EC	emulsion concentrate
EEC	European Economic Community
EPA	U.S. Environmental Protection Agency
ERL	extraneous residue limit
FAO	Food and Agriculture Organization of the United Nations
g	gram
μg	microgram
GAP	good agricultural practice
GL	guideline level
ha	hectare
IARC	International Agency for Research on Cancer
i.m.	intramuscular
i.p.	intraperitoneal
IPCS	International Programme on Chemical Safety
IRPTC	International Register of Potentially Toxic Chemicals
JMPR	Joint FAO/WHO Meeting on Pesticide Residues (Joint Meeting of the FAO Panel of Experts on Pesticide Residues in Food and the Environment and a WHO Expert Group on Pesticide Residues)
k	kilo- (x 103)
kg	kilogram
l	litre
LC_{50}	lethal concentration, 50%
LD_{50}	lethal dose, median

m	metre
mg	milligram
ml	millilitre
m.p.	melting point
MRL	Maximum Residue Limit.
MTD	maximum tolerated dose
ng	nanogram
NOEL	no-observed-effect level
NOAEL	no-observed-adverse-effect level
NS	Not Stated
OP	organophosphorus pesticide
PHI	pre-harvest interval
ppb	parts per billion
ppm	parts per million (Used only in reference to the concentration of a pesticide in an experimental diet. In all other contexts the terms mg/kg or mg/l are used).
ppt	parts per trillion
sp gr	specific gravity
STEL	Short Term Exposure Limit
TADI	Temporary Acceptable Daily Intake
TLV	Threshold Limit Value
TMDI	theoretical maximum daily intake
TMRL	Temporary Maximum Residue Limit
TWA	Time Weighted Average
UNEP	United Nations Environment Programme
WHO	World Health Organization
WP	wettable powder
wt	weight
<	less than
<<	much less than
$\leq$	less than or equal to
>	greater than
$\geq$	greater than or equal to

Prior Informed Consent Decision Guidance Document

Pentachlorophenol

1 Identification

1.1	Common Name	Pentachlorophenol and its salts and esters
	Other names/synonyms	PCP, penta, penchlorol, chlorophen
1.2	Chemical Type	Chloronitrophenol derivative
1.3	Use	Wood use: algaecide, fungicide, insecticide (wood preservative) Non-wood use: general disinfectant, herbicide, insecticide (termiticide), molluscicide, anti-fouling paint
1.4	Chemical Name	Pentachlorophenol
1.5	CAS No.	87-86-5
1.6	Trade Names	Block Penta; Chem-Tol; Cryptogil oil; Dowcide 7/EC-7/G; Dowicide G; Dirotox; EP 30, Fungifen; GLAZD Penta; Grundier Arbezol; Lautor A, Lauxtol; Lauxtrol A; Lipoprem; Pentchloral; Pentacon; Penta C 30; Penta-Kil; Penta Plus 40; Penta Pres 1-10; Penta WR1-5 Penwar; Peratox; Permacide; Permagard; Persasan; Permatox; Permite; Santobrite; Santophen; Santophen 20; Sautox, Sinituho; Term-i-Trol; Thompson's Wood Fix
1.7	Mode of action as Pesticide	It is widely believed that pentachlorophenol affects uncoupling mitochondrial oxidative phosphorylation, thereby causing accelerated aerobic metabolism and increasing heat production. It causes loss of membrane electrical resistance
1.8	Formulation Types	Wettable powder (50%), prills (or granular) (85-90%), blockform 90+%, oil-miscible liquid (5%), emulsifiable concentrate (40%). PCP is available as a sodium salt. The compound may be used alone or in combination with other agents, such as sodium fluoride, dichromate salts, sodium arsenate or arsenious oxide (Farm Chemicals Handbook, 1991).
1.9	Basic Manufacturers	Vulcan Materials Co., (Chemicals Div.), Birmingham, Alabama, USA. In the 1980s produced by Ameco,Canada; National Product Co., China; Chapman Chemicals; KMG Mernuth (Mexico); Pola Quimia SA de CB, Mexico City, Mexico; Preservation Products, Matamoros, Mexico; Melchemie, Holland; Rhône-Poulenc, Lyons, France

2 Summary of Control Actions

2.1 General

Control actions to ban or severely restrict pentachlorophenol have been reported by eight countries and the European Union. Six have banned the pesticide; two and the EU have severely restricted it.

The control actions reported by governments to IRPTC/UNEP are listed in Annex 1.

2.2 Reasons for the Control Actions

Pentachlorophenol has been subject to control actions primarily because of high toxicity to human and animals. Developmental and reproductive effects and liver and kidney pathology were noted in animal studies. However, the compound is also highly toxic to aquatic organisms. Pentachlorophenol contains several highly toxic dioxins which have shown carcinogenic effects in experimental animals.

2.3 Bans and restrictions

Pentachlorophenol continues to be used extensively. However, depending upon the reporting country, the number of banned uses ranges from all uses to few uses. Most reporting countries banned residential indoor uses. Austria, India, Indonesia, New Zealand, Sweden and Switzerland have reported a total ban.

Refer to Annex 1 for details.

2.4 Uses Reported to be Continued in Effect

Belize and China have retained uses for wood preservation purposes by licensed applicators or under specific conditions.

2.5 Alternatives

A number of chemical alternatives to PCP for wood preservation have been developed. While many of these, such as TCMTB, are as toxic as or more toxic than purified PCP, they do not contain the persistent toxic contaminants that characterize formulated PCP products. Other, less toxic PCP alternatives now in use include copper naphthanate and zinc naphthanate. PCP has been replaced by other chemical agents for virtually all of its former agricultural uses. Specific alternatives were suggested by India. Many less toxic alternatives are registered in Indonesia and Austria. For details, see Annex 2.

It is important to remember that the effectiveness of any alternative pesticide needs to be established under conditions of use in specific crops and countries.

2.6 Contacts for Further Information

FAO/UNEP Joint Data Base, IRPTC, Geneva; Designated National Authorities (DNAs) in countries taking control actions may be a source of information on alternatives (Annex 3).

3 Summary of Further Information on Pentachlorophenol

3.1 Chemical and Physical Properties

Pure pentachlorophenol forms colourless monoclinic crystals. The technical grade is a dark-grey to brown pellet/powder. Melting point is 191ºC (anhydrous), 174ºC (monohydrous). Boiling point (decomposition) 309-310ºC. The vapour pressure at 20ºC is 2 mPa. Solubility (mg/l) water: 20 mg/l at 30 ºC. It is freely soluble in organic solvents, and alcohol, soluble in benzene, ethanol and diethyl ether; slightly soluble in cold petroleum ether; carbon tetrachloride and paraffins; inflammable. Commercial PCP contains very toxic impurities. Those of greatest concern are hexachlorodibenzo-p-dioxin (HxCDD), 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD), the chlorinated dibenzofurans and hexachlorobenzene (HCB) (Royal Society of Chemistry, 1991; Pesticide Manual, 1991).

3.2 Toxicological Characteristics

3.2.1 Classification

WHO	Class Ib (highly hazardous :WHO, 1994)
EU	Carcinogen (Cat.3): highly toxic; irritant
IARC	No evaluation of carcinogenicity because data are inadequate

3.2.2 General

PCP is highly toxic to mammals and birds. It is the most acutely toxic of the chlorophenols tested. Some of the acute effects of exposure to commercial PCP are attributable to microcontaminants present in the technical preparation (IPCS, 1987).

Uptake: PCP is readily absorbed when applied to the skin

3.2.3 Acute Toxicity

Oral	LD_{50}: 27-205 mg/kg (tests with a variety of species) (IPCS, 1987)
Inhalation	Rabbit (35.2%) LD_{50} 201 mg/kg
Dermal	LD_{50}: 80-350 mg/kg (tests with a variety of species) (IPCS,1987)
Irritation	Irritating to skin, eyes and mucous membranes (US PHS, 1989; IPCS, 1987)

3.2.4 Short-term Toxicity

Reproduction: Numerous studies have described the developmental effects of pentachlorophenol and its dioxin and hexachlorobenzene contaminants. PCP is foetotoxic and teratogenic when administered during early gestation (Eisler, 1989). There is a general agreement that PCP is a foetotoxic agent; however, it does not appear to be teratogenic (NRCC, 1982). It was concluded that the NOEL for teratogenicity, foetotoxicity and embryotoxicity in rats was 10 mg/kg.

NOEL The NOEL was determined to be 1.25 mg/kg/day (25 ppm, LDT) subchronic inhalation (rat) study.

3.2.5 Chronic Toxicity

Carcinogenicity PCP was tested for carcinogenicity by administration in the diet of two strains of mice and in one experiment in rats (IARC, 1979). The data available on the carcinogenic properties of PCP were reviewed and it was concluded that no carcinogenic effects were evident in either species. The IARC therefore concluded that there is inadequate evidence for carcinogenicity to animals (IARC, 1987). A review of data by the Carcinogenic Assessment Group of the US EPA concluded that PCP was negative with respect to oncogenic effects (Williams, 1982).
The same studies in mice (Innes *et al.,* 1969;) did not indicate significant increases in tumour incidence.

Mutagenicity PCP probably does not cause mutations. The data available are insufficient to fully assess the mutagenicity of PCP (Williams, 1982).

Others PCP has proved to be immunotoxic for mice, rats, chicken and cattle. Neurotoxic effects have also been reported (IPCS, 1987).

3.2.6 Epidemiological Data

Most of the available information regarding effects of pentachlorophenol in humans comes from cases of acute over-exposure following the home use of PCP in wood preservation and herbicides and occupational exposure in agriculture and the wood treatment industry. The few available industrial surveys and epidemiological studies are limited in their usefulness because of small sample size, short follow-up periods and brief exposure periods. Nevertheless, these studies suggest that PCP can adversely affect the liver, kidney, skin, blood, lungs and central nervous system.

3.3 Environmental Characteristics

3.3.2 Effects

PCP is highly toxic to aquatic organisms. Invertebrates and fish are adversely affected by concentrations of PCP below 1 mg/l; algae are very sensitive to PCP.

Fish PCP LC_{50}: Bluegill 23-92.5 µg/L., Rainbow trout 48-68.7 µg/l

Aquatic Invertebrates Eisler (1989) reported a 48-hour median lethal concentration (LC_{50}) of 260 µg/l for the clawed toad

Birds Avian toxicity may be somewhat less sensitive to PCP than mammalian: LD_{50}s 380 mg/kg bw for mallard duck and 504 mg/kg bw for ring-necked pheasant

3.4 Exposure

3.4.1 Food/drinking water

Low use in foods. However, in countries where large amounts of PCP have been used, contamination of foods and feed commodities is probably from environmental movement. Therefore, consumption of contaminated foods represents the primary route for most people (UN ECE, 1994). Overall estimates of PCP intake from all foods, based on total diet samples in the USA and Germany, range up to approximately 6 µg/person per day (IPCS, 1989).

3.4.2 Occupational/Use

The extensive use of PCP to treat wood, and to a lesser extent use in homes and gardens, together with its physical and fate characteristics indicate that there is likely to be widespread human exposure occurring partially through skin contact, but mainly through inhalation, which is the most dangerous route of exposure to PCP. This is confirmed by many reports of its occurrence in the general environment and its presence in body-fluids, both in the general population and in exposed workers (Fielders *et al*., 1982). Airborne levels of PCP production and wood-preservation facilities have ranged from several mg/m^3 to more than 300 mg/m^3 in some work areas. Under these circumstances, the ADI may be significantly exceeded.

Domestic use, such as indoor application of wood preservatives and paints based on PCP or PCP-treated wood or indoor wood panels or boards, leads to high concentrations in the indoor atmosphere, and the ADI may be significantly exceeded.

3.4.3 Environment

The relatively high volatility and mobility of PCP and the water solubility of its ionized form have led to the widespread contamination of all environmental sectors, and a long-range dissemination of this compound. PCP will leach from treated wood, volatilise from treated surfaces and may get into waterways, adversely affecting fish.

3.4.4 Accidental Poisoning

IARC (1979) reports one case of fatal aplastic anaemia from exposure to pentachlorphenol and tetrachlorophenol and the death of nine sawmill workers exposed to treated wood Two deaths were reported among 20 infants intoxicated in a hospital due to the misuse of a laundry product containing 22.9% sodium penta-chlorophenol, 4% 3,4,4-trichlorocarbanilide and sodium salts of other chlorophenols and inert ingredients. Extended periods of exposure to PCP have resulted in persistent chloracne and disorders of the nervous system and liver. There are first aid treatments available for ingestion, inhalation and contamination of the eye and skin. Notes to physicians are also available.

3.5 Measures to Reduce Exposures

Exposure may be reduced by providing protective clothing. Where dermal contact is expected wear gloves. Spray applicators should wear protective clothing (e.g. overalls, jacket, gloves and boots) which is impervious to wood treatment formulations, plus a respirator, head covering and goggles when spraying Keep clothes clean or dispose of clothing Do not eat, drink or smoke when contaminated from applying PCP. Automated processes and the use of closed systems, where applied, have greatly reduced worker-exposure.

3.6 Packaging and Labelling

The product should be labelled explicitly. Handling instructions are required. For further advice refer to the FAO Revised Guidelines on Good Labelling Practice for Pesticides (1995).

3.7 Waste Disposal Methods (WHO/IPCS, 1990)

The disposal of technical PCP and associated waste should preferably involve controlled high-temperature combustion with effluent gas scrubbing to prevent release of hydrogen chloride gas.

3.8 Maximum Residue Limits (mg/kg)

Codex/JMPR ADI:	The Codex/JMPR has no established ADI for Pentachlorophenol
Codex MRLs:	The Codex/JMPR has no established MRLs for Pentachlorophenol
Belgium:	Maximum permissible levels in mg/kg: mushrooms 0.05; other 0* (0.01). * ISO designation
Germany	(Maximum levels in mg/kg) All foods of plant origin 0.01.
Israel	(Maximum residue limits in mg/kg.) Mushrooms and other foods 0.05.
Netherlands	(Maximum residue limits in mg/kg) Mushroom 0.05; other 0* (0.01*). Note: (*) residues shall be absent, while the highest concentration at which this requirement is still deemed to have been met is indicated in parentheses
Switzerland	(Limit value in mg/kg) Milk 0.05.
Yugoslavia	(Tolerance level in ppm) Unnamed commodities 0.01.

4 Major References

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Williams, P.L. (1982). Pentachlorophenol: an assessment of the occupational hazard. Am. Ind. Hyg. Assoc. J., 43:799-810

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ANNEX 1

Summary of Control Actions and Remaining Uses as Reported by Countries

Actions taken and year effective

Bans

Austria	
Control Action	Pentachlorophenol and its salts are banned
Effective	1991
Uses still allowed	Use is still allowed for scientific and analytical purposes
Reasons for control action	Highly toxic impurities in commercial products (chlorinated dibenz o-p-dioxin: CDDs) and chlorinated dibenzofurans (CDFs) and formation of highly toxic compounds on combustion. CDDs and CDFs have shown carcinogenic effects in experimental animals.

India	
Control Action	Banned
Effective	1991
Uses still allowed	
Reasons for control action	Owing to high toxicity to man, animals and aquatic organisms and presence of toxic impurities in commercial products

Indonesia	
Control Action	Prohibited for all uses
Effective	1980
Uses still allowed	No remaining uses allowed
Reasons for control action	Extremely toxic; may be fatal if swallowed or absorbed through skin; causes skin irritation; vapours will cause injury

New Zealand	
Control Action	1) All uses and products are banned 2) Agreement in principle to permit re-introduction in closed timber treatment systems at approved sites with specific conditions on disposal of waste. These conditions have not been met and therefore no products registered, no use permitted and no imports allowed
Effective	1991
Uses still allowed	No remaining uses allowed
Reasons for control action	

Sweden	
Control Action	Pentachlorophenol and other chlorophenols are banned
Effective	1978
Uses still allowed	No remaining uses allowed.
Reasons for control action	Because of highly toxic impurities in commercial products

Switzerland	
Control Action	Totally banned chemical: manufacture, supply, import and use of the substance and of products which contain the substance are prohibited. (Applies to pentachlorophenol, its salts and pentachlorophenoxy compounds)
Effective	1988
Uses still allowed	No remaining uses allowed
Reasons for control action	Bioaccumulation, highly toxic impurities, formation of highly toxic substances on thermolysis

Severely Restricted

EU/EEA[1]	
Control Action	Pentachlorophenol, its salts and esters shall not be used in a concentration equal to or greater than 0.1% by mass in substances or preparations placed on the market for use by the general public.
Effective	1992
Uses still allowed	Does not apply to substances and preparations for use in industrial installations with emission and/or discharge of PCP greater than those prescribed by existing legislation; and only (a) in the treatment of wood neither intended for use inside buildings, nor for manufacture of containers intended for growing purposes, nor manufacture of packaging for products intended for human and/or animal consumption; (b) in the impregnation of fibres and heavy-duty textiles not intended for clothing or for decorative furnishing; (c) as a synthesizing and/or processing agent in industrial processes; (d) by way of special exception for remedial treatment of timber and masonry infected by dry rot fungus (*Serpula lacrymans*).
Reasons for control action	PCP, its salts and its esters are dangerous to man and the environment, and in particular to the aquatic environment. They have been classified by the EC as category 3 carcinogens (possibly carcinogenic to humans)

Belize	
Control Action	Severely restricted
Effective	1985
Uses still allowed	Wood preservation purposes only by approved and certified establishments and personnel

[1] Members of the European Union (EU): Austria, Belgium, Denmark, Finland, France, Germany Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, United Kingdom
Members of the European Economic Agreement (EEA): Iceland, Liechtenstein, Norway

Reasons for control action	Oncogen, mutagen, teratogen, high dermal toxicity

China	
Control Action	Pentachlorophenol has been banned for registration and production, sale and use as pesticide. Uses are only allowed as wood preservative.
Effective	1982
Uses still allowed	Use is still allowed as germicide on woods. However, areas and methods of approved application as stated in "Bulletin of Pesticide Registration" should be observed.
Reasons for control action	These measures were taken because pentachlorophenol is a highly toxic germicide and its abuse is severely harmful to human health
Date of notification	

ANNEX 2

Alternatives

The following alternatives were noted by countries reporting import decisions under the PIC procedure:

Country	
Austria	Many alternatives for designated purposes
India	Paraquat as herbicide. TCMTB as fungicide.
Indonesia	Many less toxic wood preservatives already registered

It is essential that before a country considers substituting any of these reported alternatives, it ensures that the use is relevant to their national needs. A first step may be to contact the DNA in the country where the alternative has been reported (see address: Annex 3). It will then be necessary to determine the compatibility with national crop protection practices.

ANNEX 3

List of Pesticide DNAs in Countries Reporting Control Actions or Alternatives

Belgium	CP	Service Maîtrise des risques Section Pesticides (bureau 2/309) Ministère de la santé publique et de l'environnement Cité Administrative de l'Etat 1010 Bruxelles (Attn. Mr. R. Huysman)	Tel: 32 2 2104881 Fax: 32 2 2104884
Belize	P	The Secretary Pesticides Control Board Department of Agriculture Central Farm Cayo	Tel: 501-92-2640 Fax: 501-92-2640 Tlx: 102 Foreign Bz
	C	Mr. Carlos Guerra Sanitation Engineer Ministry of Public Health Public Health Bureau Belize City	
China	P	The Director Institute for the Control of Agrochemicals (ICAMA) Ministry of Agriculture Liang Ma Qiao, Chaoyang Beijing 100026	Tel/Fax: 86 010 5025929
	CP	National Environmental Protection Agency (NEPA) No. 115, Xizhimennei Nanxiaojie Beijing 100035 (Attn.: Mrs Sun Lijin)	Tel: 8329911, Ext. 3555/3609 Tlx: 222359 NEPA CN Fax: 8328013
India	P	The Director/Deputy Secretary Plant Protection Division Dept. of Agriculture & Co-op. Room No. 244-A Krishi Bhavan, New Delhi	
	C	Adviser (Chemicals) Dept. of Chemicals & Petrochemicals Ministry of Chemicals & Fertilizers Shastri Bhavan Rajendra Prasaid Road New Delhi - 110 001	Tel: 91 (11) 385736/382575 Tlx: 62455 Fax: 91 (11) 382604/337223
Indonesia	P	Chairman Pesticides Committee Direktorat Bina Perlindungan Tanaman Jln. AUP. Pasar Minggu Jakarta Selatan	Tel: 62 (21) 7805652/7806213 Fax: 62 (21) 7805652

	CP	Ms. Masnellyarti Hilman Bapedal Offices Arthaloka Bldg., 11th Floor Jl. Jend. Sudirman No. 2 Jakarta Pusat	Tel: (021) 583918 Tlx: 62 21 583918 Fax: (021) 5703365
Kuwait	P	The Director Plant Wealth Department The Public Authority for Agriculture Affairs & Fish Res. P.O. Box 21422 13075 Safat	Tel: (965) 2452790, 2456835/36 Tlx: 46408 EP CNCL KT Fax: (965) 2421993-2456836
New Zealand	CP	Mr. D.W. Lunn Chief Scientist (Pesticides) Agricultural Compounds Unit Ministry of Agriculture & Fisheries P.O. Box 40-063 Upper Hutt	Tel: 064 4 528-6089 Fax: 064 4 528-4675
Sweden	CP	National Chemicals Directorate Attn.: Mr. Ule Johansson P.O. Box 1384 171 27 Solna	Tel: 46 (8) 730 6004 Tlx: 10460 AMS S Fax: 46 (8) 735 7698
Switzerland	CP	Service des affaires internationales Office fédéral de l'environnement, des forêts et du paysage (OFEFP) Hallwylstr. 4, 3003 Berne	Tel: 41 31 322 99 73 Fax: 41 31 322 99 81 Tlx: 91 23 04
USA	CP	The Assistant Administrator for Pesticides and Toxic Substances Environmental Protection Agency 401 M St. S.W. Washington DC 20460	Tel: 1 202 260 2902 Fax: 1 202 260 1847 Tlx: 892758 EPA WSH

	C	Industrial and consumer product chemicals
	P	Pesticides
	CP	Pesticides, industrial and consumer product chemicals