Organochlorines Programme
Ministry for the Environment

Bulletin No 6

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Included in Bulletin 6 are items on:

- Destruction of organochlorine pesticides
- Public consultation for the Organochlorines Programme
- Environmental risk assessment for organochlorines
- UNEP convention on POPs

Destruction Of Organochlorine Pesticide Wastes
Introduction

Regional councils have collected considerable amounts of unwanted pesticides from agricultural communities. These are being stored until an efficient and cost-effective method can be found to destroy them. Councils are considering their options in the event that a suitable New Zealand-based treatment is not available.

At present there is no company operating in New Zealand that destroys organochlorine pesticides as a commercial service. However, prospects are being explored by two vendors and this could lead to the establishment of a NZ-based facility within the coming year.

This article covers recent developments in three pesticide destruction technologies and reports in detail the results of a New Zealand trial of one of these technologies - known as ADOX/BCD (accelerated decomposition of organic halides/base-catalysed decomposition). The trial has demonstrated the safe destruction of organochlorine pesticide wastes, including DDT and dieldrin. The trial was undertaken by ADI Limited (ADI) and Environmental Science and Research Limited (ESR). ADI is a publicly listed company in Australia and ESR is a New Zealand Crown Research Institute.

ADOX/BCD and thermal desorption technologies

An ADOX/BCD trial, undertaken in 1997, complements a feasibility study of a thermal desorption method (enhanced indirect thermal decomposition) to treat soils contaminated with pentachlorophenol, dioxin and organochlorine pesticides. We reported the results of this latter study in the Organochlorines Programme Bulletin (No. 5, July 1997).

ADI claims that both technologies, used either separately or in combination, provide a safe, robust and effective means to destroy the organochlorine pesticide wastes. Furthermore, ADI are confident that their thermal desorption technology can also safely destroy most fungicides and organophosphate pesticides.

RM Act consents would be needed for the commercial operation in New Zealand of these technologies. A company capability statement on these technologies is available on request from:

Robin Apted, Projects Manager Environment, ADI Limited, Major Projects Group, Level 6, 100 William Street, East Sydney NSW 2000 AUSTRALIA phone 612 9116 4962 ; Fax 612 9358 5673

CURE technology

A third new technology, CURE, has been developed specifically for the treatment of organochlorine wastes. The fundamental research on CURE was carried out by CSIRO (Commonwealth Scientific and Industrial Research Organisation), Australia. The commercialisation of the technology is being undertaken by a consortium comprising Clough Engineering, Radian Corporation (a subsidiary of Dow Chemical), and United Environmental Ltd (UEL), as the NZ partner.

The consortium currently intends to establish the CURE technology business in Australia. A capability statement about the CURE process is available on request from: Terry Deed, United Environmental Ltd, PO Box 58032 Greenmount, Auckland; ph 09 274 7963

ADOX/BCD treatability trials

ADI and ESR carried out a series of laboratory and pilot plant trials to test the effectiveness of organochlorine (OC) pesticides. They also wanted to find out what chemicals would be discharged form the process, and at what concentrations. This information was necessary to decide whether consents would be needed under the Resource Management Act for a commercial ADOX/BCD plant.

The full scientific report provided to the Ministry (*The use of ADOX/ BCD technology for the destruction of organochlorine pesticides wastes: treatability study, ADI Limited & ESR Limited, May 1998*) presents the results of laboratory and pilot plant trials that evaluated the effectiveness of the ADOX/BCD process.

The pesticides treated

Pesticides destroyed in the trial included lindane, dieldrin, DDT, and pentachlorophenol (PCP). Each trial batch contained up to 30 kg of pesticide. The pesticides included a variety of formulations and concentrations. Some of these contained carrier, solvent or wetting agents which changed the rate of the decomposition reaction, and made some adjustments to the ADOX/BCD process necessary.

Destruction targets

The target destruction levels selected for the trials were:

- 2 mg/kg (2 ppm) total organochlorine pesticide after treatment (referenced to the Organochlorine Pesticides Management Plan, ANZECC, 1997).
- 5 ng/kg (5 ppb) dioxin I-TEQ (international toxic equivalents) after treatment of PCP
- air emissions less than 0.1 ng/m^3 dioxin I-TEQ during treatment of PCP.

Table 1:
Organochlorine pesticides used in ADOX/BCD trials.

Active Ingredients	Product Name
Dieldrin	Dieldrex 50
Lindane	Lindane 50 W
Lindane	Lindane 50
DDT	DDT prills
DDT	D Spray 50%
DDT	DDT 20 EC
Tetradifon	Tedion 20%
PCP	Sodium PCP 85%

Laboratory

Preparatory laboratory-scale trials were undertaken as a precaution and to optimise the ADOX/BCD process on the waste materials before proceeding to pilot trials. The laboratory programme confirmed that the active pesticide ingredients would be safely destroyed by the pilot plant. The most appropriate method to prevent foaming associated with quicker than normal reaction rate was identified..

Pilot scale

The treatability trials were undertaken in ADI's BCD liquids plant. No pre-treatment to purify or concentrate these compounds was undertaken prior to the ADOX/BCD treatment. This was important to establish if mixtures and impurities affected the ADOX/BCD chemical reaction.

The organochlorine pesticides are dispersed in an oil slurry and slowly added to a mixture of hot oil (at a temperature of about 320 ^{0}C), ADOX accelerant and sodium hydroxide. Oxygen is excluded from the whole system. In the reaction, the pesticide compounds are decomposed and converted to carbon and sodium chloride. The reaction is normally completed within 2 hours but the full cycle takes approximately 8 hours.

During ADOX/BCD treatment the following materials and substances are produced:

- **Reactor product** - an oily product that remains in the reactor on completion of the treatment process;
- **Reaction residue** - a quantity of water (aqueous) and organic solvent that is purged from the reactor, condensed and retained in the collection sump.

The results demonstrated that the ADOX/BCD process reduced total organochlorine concentration from between 5 -12 percent in the feedstock to less than 0.05 ppm and 0.02 ppm total organochlorine in the reaction residue and reactor product respectively. This is well below the target level of 2 ppm, which is defined as "Exempt organochlorine pesticide waste" as defined by ANZECC. The process yields a destruction removal efficiency of greater than 99.9999 percent. Summary data on feedstocks and reactor products in the trials are in Table 2.

Two pentachlorophenol (PCP) runs were included in the trials to demonstrate the destruction of PCP. The total organochlorine levels in the reactor product were less than 0.05 ppm. However, dioxin levels in the reactor products of 5 % w/w PCP and 10% w/w PCP trial runs were 4.29 ppb and 49.8 ppb I-TEQ respectively. The ability of the ADOX/BCD reaction to destroy the

more recalcitrant dioxins to less than 0.5 ppb I-TEQ has been demonstrated in the laboratory scale, however. ADI is confident that this will also be possible when the pilot unit is operated under optimal conditions with a higher operating pressure, a longer reaction time, or a combination of both.

Reactor products and residues

Waste materials and liquids may contain low levels of contaminants and it is important to identify these before selecting the appropriate route of disposal, in consultation with regulatory authorities.

The oily reactor product from all except the PCP runs (refer below) is suitable for disposal. In practice an oil fraction can be reclaimed for recycling or reuse, and ADI are investigating a treatment that would transform the remainder of the product into a commercially useful material.

The liquid (aqueous and solvent phase) wastes contained a total organochlorine content of less than 1.0 ppm. These wastes were reprocessed at the end of the trials, resulting in waste liquids containing total organochlorine of less than 0.01 ppm. The water fraction would be suitable for discharge to the sewer and the organic fraction would be suitable for disposal or reuse as a solvent.

As described above, the oily reactor product arising from the two PCP trials contained dioxin levels in excess of 0.05 ppm I-TEQ. These will be returned to the reactor for reprocessing.

The liquid aqueous and organic solvent residues from the PCP runs contained dioxin levels of 0.03 ppb I-TEQ and 0.0067 ppb I-TEQ respectively, well below the target level 5 ppb. No further treatment would be required before disposal.

Air emissions

The ADOX vessel is designed to operate up to a pressure of 20 bar. These trials, however, were permitted only on the condition that vessel pressure did not exceed 5 bar. As a result, intermittent (and infrequent) fugitive emissions of excess N_2 gas to air were necessary in order to meet this constraint.

The contaminants in the gas emissions during the trial were captured by a polyurethane foam (PUF) cartridge and filter provided for each trial run. The amounts emitted were measured as a total mass collected over the duration of the trial. The PUF cartridges yielded a total quantity of 0.46 mg OC, 0.33 mg PCP and 0.04 ng I-TEQ dioxin for the 264 hours operation.

The emission control system prevented any contaminants being discharged to the atmosphere. The normal operation of the ADOX unit at 20 bar leads to two outcomes. First there would be no fugitive emissions. Second, operation at higher pressure would reduce reaction time and assist the efficiency of reaction parameters.

Conclusions

This work has shown that a range of formulated organochlorine pesticides with various filler materials can be effectively and safely treated using the ADOX/BCD process.

The selected target levels of total organochlorine of 2 mg/kg (2 ppm) or less, can be easily achieved using the ADI's small scale plant which yielded a destruction efficiency of greater than 99.9999 percent for all pesticides treated.

Following the treatment of PCP, dioxin levels in the liquid reaction residue were less than the target of 5 ppb I-TEQ, but in one run were higher than this target for the reactor products. With further optimisation, improved dioxin destruction efficiencies (to less than 0.5 ppb I-TEQ) are expected for the reactor products.

We hope that reporting this project will help build community confidence in the capacity of the ADI-ESR team to successfully apply their ADOX/BCD technology to the treatment of organochlorine pesticide wastes in New Zealand

Table 2: Summary of results of feed and reactor product.

Organochlorine pesticide type	Before treatment Total organochlorine in feedstock (ppm)	After treatment Total organochlorine in reactor product (ppm)
DDT prills (pellets)	36,400	<0.02
DDT powder (D spray)	4,860	<0.02
DDT powder	95,700	<0.02
DDT prills	87,600	0.032
DDT emulsified concentrate (20 EC)	48,000	0.021
Dieldrin	45,700	<0.01
Dieldrin	96,100	<0.01
Lindane	53,800	<0.03
Lindane	96,100	<0.05
NaPCP	47,500	<0.05
NaPCP	95746	<0.03
Residues	-	<0.01

Organochlorines Programme Public Consultation 1998/99

The development of National Environmental Standards (NES) for dioxins and PCBs will be the major focus of the Organochlorines Programme in 1998/99. During the year we plan to:

- provide public information on the research findings of the Organochlorines Programme;
- prepare documentation specific to risk assessment and NES;
- consult with the community
- revise draft policy documents in the light of public comment.

Public information

Scientific research

During the coming year we expect to publish a series of documents. These will include scientific reports on the level of organochlorine contaminants found in surveys of the environment, food, and human serum.

The first set of reports, which will be published on 1 September 1998, will be on the investigations of background levels of organochlorines found in the New Zealand environment (soils, rivers, estuaries and air) and of the levels found in food. Two other investigations, on blood serum levels of organochlorines, and an inventory of dioxin emissions, are scheduled for publication in 1999.

Risk assessments

Two international experts will lead the risk assessment phase of the Organochlorines Programme. They are Professor John Giesy, Distinguished Scientist and Professor of Ecotoxicology, Michigan State University (who will lead the ecological risk assessment); and Professor Allan Smith, Professor of Epidemiology, University of California (who will lead the human health risk assessment).

Both professors will be supported by a small team of NZ scientists. The role of the assessment teams will be to provide the Ministry for the Environment and the Ministry of Health with an internationally authoritative opinion on the significance of the NZ data in a world context, to consider the issues and options for NZ with reference to regulations and standards adopted in other countries, and, recommend standards for dioxins and PCBs that will adequately protect people's health and the environment. Publication of the assessments are timetabled for mid-September (environment) and mid November (health).

Public consultation

Public meetings will be held to present the findings of the Organochlorines Programme, to discuss the issues associated with the development of the NES, and to invite public submissions. The meetings are scheduled for a 3-month period from September to November 1998, including hui with iwi-Maori.

Consultation on proposed National Environmental Standards requires "adequate time and opportunity to comment on the proposed subject matter" (s.44 Resource Management Act). The MfE will prepare consultation documents to guide respondents in their consideration of the key policy issues.

A paper prepared for public comment at the beginning of the consultation period will provide the policy context for the development of National Environmental Standards.

The paper, "Proposed framework for organochlorines management" will outline proposals for a management plan and guidelines for organochlorines. It will also cover in more detail the issues associated with the development of National Environmental Standards for dioxins and PCBs.

The paper will also include a timetable for the development of the National Environmental Standards, and outline the opportunities for community input.

Policy development and decision-making

We will take into account the criteria for environmental and health risks recommended by Professors Giesy and Peterson, and the public submissions from the consultation when we write proposed standards and guidelines for:

- controlling emissions to air;
- controlling discharges to water and land;
- cleaning up of contaminated soil.

Three documents are scheduled for publication in March 1999:

- draft proposed organochlorines management plan;
- draft proposed National Environmental Standards for dioxins and PCBs;
- draft proposed guidelines for organochlorine pesticides.

These documents will be circulated to interested people for comment. Any evident divergence of views will be identified and analysed, and the preferred Government view be indicated. Further comment will be sought specific points.

The of National Environmental Standards report, the recommended standards, and any points on which final decisions are needed on matters of principle will then be submitted to the Minister for the Environment. If appropriate, final decisions can be made by Cabinet.

The approved of National Environmental Standards and the associated report will be released as a public document. The standards will be promulgated as regulations under the Resource Management Act. It seems likely that the standards proposed for dioxins and PCBs will be the first to be developed under the Act. The following table provides a summary of the key documents expected to be published by the Organochlorines Programme during 1998/99.

Organochlorines Programme 1998/99: Timetable for key documents

Type of Document	No	Document	Target date
Scientific & Technical Reports		Ambient Data for Organochlorines in the NZ Environment:	
	1	• soils	1 Sept 98
	2	• rivers (water & finfish)	1 Sept 98
	3	• estuaries (sediments & shellfish)	1 Sept 98
	4	• air	1 Sept 98
	5	Human Exposure to Organochlorines: Food and Dietary Intake	1 Sept 98
Public consultation		1st round (environment)	Sept/Oct 98
	6	New Zealand Inventory of Dioxin emissions	June 99
	7	Human Exposure to Organochlorines: Serum Survey	June 99
Public Information	**8**	Summary of Organochlorines Programme Research	June 99
Public consultation		2nd round (human health)	June99
Scientific & Technical	**9**	draft Ecological Risk Assessment	Sept 99
Reports	**10**	draft Human Health Risk Appraisal	Sept 99
Iwi consultation	**11**	Iwi Consultation Paper	Sept 99
Public Information	**12**	A Proposed Framework for Organochlorines Management	Oct 99
Public consultation		3rd round (National Environmental Standards and Management Plan)	Oct 99
	13	Draft of National Environmental Standards for Dioxins and PCBs	Dec 99
	14	Draft Guidelines for Organochlorine Pesticides	Dec 99
	15	Recommended of National Environmental Standards for Dioxins and PCBs	30 Jun 00

Environmental Risk Assessment

The environmental risk assessment for the Organochlorines Programme is now underway. The risk assessor leading the project is Professor John Giesy, Michigan State University. Professor Giesy is recognised internationally for his work in organochlorines, particularly for his assessment of the impact of PCBs, dioxins and organochlorine pesticides on the environment of the Great Lakes in North America. He will be supported by a small team of NZ scientists.

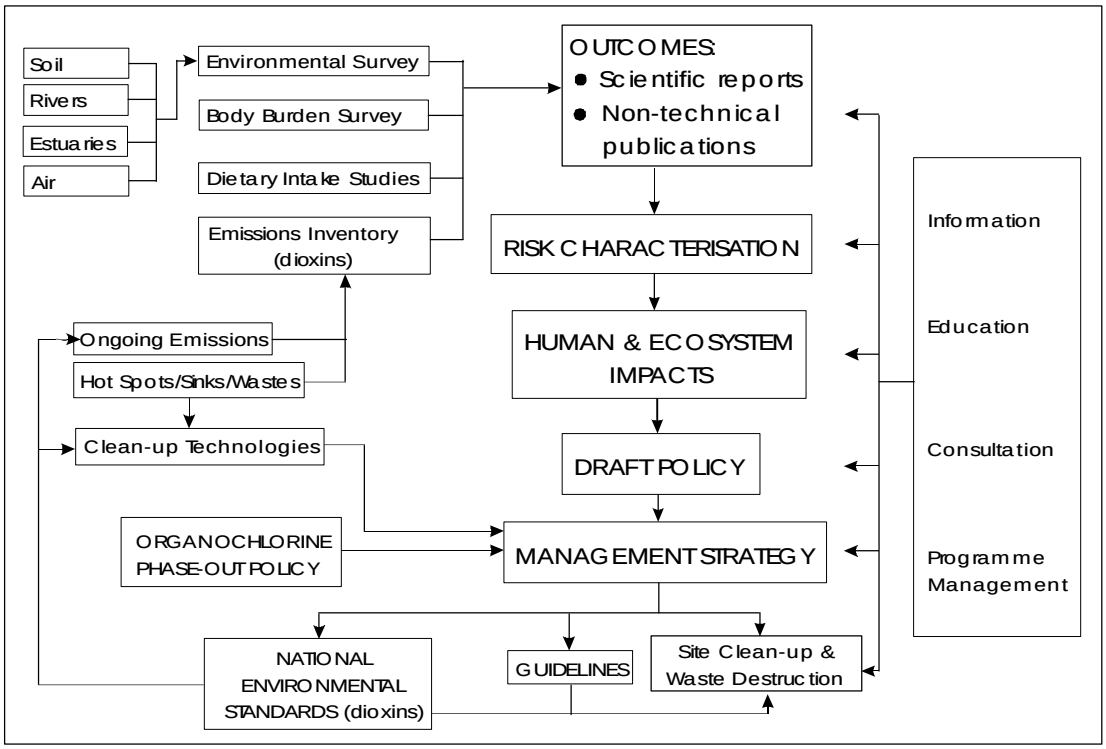
The environmental risk assessment is to look at NZ data on two levels:

- the status of background levels of contamination New Zealand-wide in air, water, soil, sediment, and aquatic ecosystems.
- the status of impacted local environments, and species, in which contaminant levels are found to be significantly greater than the NZ background. We will be seeking an expert judgement on the level of risk likely to be present in these areas, taking into account factors such as persistence and bioaccumulation of the contaminants, and the quality of the data.

The risk assessment will look at environmental data concerning levels of dioxins, PCBs, and a range of organochlorine pesticides including DDT, dieldrin, chlordane, and pentachlorophenol.

A human health risk assessment is also to be undertaken for the Organochlorines Programme later in the year. The two assessments will to provide an important input for policy recommendations involving an organochlorines management strategy, and National Environmental Standards and guidelines.

Figure 1. The conceptual model of the Organochlorines Programme



The merits or adopting precautionary standards in New Zealand to protect the environment and human health, depend on obtaining an accurate understanding of the present situation, considering the environmental policies of a number of reference countries, and taking account of New Zealand cultural values. These issues will be addressed during the consultation phase of the Organochlorines Programme.

The conceptual model that is being followed to develop the NZ policy is outlined in Figure 1.

Preparing for Global POPs Negotiations

A new international convention on persistent organic pollutants (POPs) is to be developed by the United Nations Environment Programme (UNEP). The convention will identify the actions to be taken to protect human health and the environment by minimising emissions and discharges of POPs. The persistent chemicals targeted under the convention are a list of 12 chlorinated chemicals including dioxins, PCBs, and a number of organochlorine pesticides such as DDT and dieldrin.

It is expected that the convention will comprise a range of measures, some of which will be mandatory. It is proposed that the convention be negotiated over the next two years and be ready for signing by Governments in the year 2000.

The commitment of UNEP to develop the POPs convention is the culmination of international concern over the presence in the environment of persistent and toxic man-made contaminants that bioaccumulate through the food chain.

"Evidence about the likely health effects of POPs is steadily growing. Effects can include cancer, allergies and hypersensitivity, and diseases of the central and peripheral nervous systems and the immune system. Reproductive disorders are thought to result from chemicals that function as "endocrine disruptors". Interference with the development of and the immunological system of children is of particular concern". (Extract from UNEP press release, April 1998).

The 1st session of the Intergovernmental Negotiating Committee on POPs (INC-1) is to be held in Montreal 29 June - 3 July 1998. A New Zealand delegation comprising Matthew Gubb (New Zealand Permanent Mission to UN, Geneva) and Howard Ellis (Ministry for the Environment) will be participating at this meeting. The INC meeting is likely to elect a Bureau to administer the negotiations; hear country opening statements; decide the scope of negotiations and establish working groups in technical, legal, and policy areas.

Preliminary views will be canvassed to identify additional POP chemicals that could be added to the convention in the future. Throughout the coming years an understanding of the global exposure to POPs will be developed. One of the key problems to be solved is to find an effective alternative to the use of DDT in the control of mosquito's that spread diseases such as malaria.

Eight regional workshops have been held by UNEP over the past six months to assist governments prepare for INC negotiations and identify immediate national actions. Key issues emerging of importance to New Zealand include the need for:

- inventories of dioxin emissions, waste stocks of PCBs and organochlorine pesticides;

- the development of technologies able to safely destroy waste POPs and to clean up sites contaminated by POPs;
- country case studies (eg national profiles) on how POPs problems and risks are being tackled;
- information exchange networks.

As a result of the Organochlorines Programme, New Zealand is well placed to participate fully in the UNEP negotiations. UNEP has sent questionnaires to all countries requesting detailed information on POPs production, use, trade, alternatives, stockpiles, releases, sources, exposures, monitoring, and regulation. The consolidated findings will help characterise POPs risks and exposures regionally and globally. Socio-economic costs and benefits of response strategies are to be evaluated and a POPs experts database compiled. Reference material is available from the UNEP Internet homepage: http://irptc.unep.ch/pops

Other POPs-related fora:

Negotiations on the UNEP POPs convention will draw on the experience of other intergovernmental activity currently addressing POP issues:

- UNEP Global Plan of Action for the Protection of the Marine Environment from Land-based activities;
- LRTAP convention (Long Range Transboundary Air Pollution) of the UNECE (Economic Commission for Europe).

Updates about the Organochlorines Programme

Progress reports of other Organochlorines Programme studies will be reported in Bulletin 7:

- New Zealand inventory of dioxin emissions;
- Iwi case study of the Tarawera River;
- Organochlorine contaminant levels in serum of the New Zealand population;
- Food and dietary intake of organochlorines.

ORGANOCHLORINES CONSULTATIVE GROUP

Howard Ellis	Ministry for the Environment (Chair)
Dr Simon Buckland	Ministry for the Environment
Ian Cairns	Ministry of Agriculture & Fisheries
Paul Dell	Local Authorities
Dr Donald Hannah	Environmental Risk Management Authority
Jim Waters	Ministry of Health
Non-Government Organisations	
Dr Jim Barnett	Agricultural sector
Mark de Bazin	Timber industry
Bill Birch	AGCARM, NZCIC, Waste Disposal industry
Dr Simon Hales	ECO
John Hohapata	Adviser on iwi
Jocelyn Keith	nominee of Ministry of Women's Affairs
Peter Sligh	Pulp and paper industry
Michael Szabo	ECO
Norm Thom	CAE, IPENZ, NZIC, WMINZ
Technical Specialist	
Dr Michael Bates	ESR Communicable Diseases Centre