Chlorinated Insecticides
Volume I
Technology and Application

Author:
G. T. Brooks
The University of Sussex
Brighton, Sussex
England

ROBERT E. KRIEGER PUBLISHING COMPANY
MALABAR, FLORIDA
1983
# Chlorinated Insecticides: Technology and Applications

## Table of Contents

### Chapter 1
**Introduction** .................................................. 4

### Chapter 2
**Chlorinated Insecticides of the DDT Group** ..................... 7

**A. History and Development** ....................................... 7

1. Origins and Applications in World War II ..................... 7

2. Development of Application Methods .............................. 18
   a. As Sprays, Dusts, Emulsions, etc. ............................ 18
   b. More Durable Formulations .................................... 22

3. Applications in Pest Control ..................................... 26
   a. Toxicity to Plants and Beneficial Insects ................... 26
   b. Agricultural Applications .................................... 28
   c. Public Health, Veterinary, and Other Applications .......... 35
   d. Current Status of DDT ........................................ 39

**B. Synthesis, Physical, and Chemical Properties** ............... 46

1. General Synthetic Routes ......................................... 46

2. Technical Materials and Physical Properties .................... 52

3. Constitution and Chemistry ..................................... 59

**C. Principles of Analysis** ........................................ 68

1. Gravimetric, Total Chlorine, Colorimetric Analysis ............ 68

2. Spectrophotometry, Polarography, Isotope Techniques .......... 73

3. Analysis and Structure Determination of Organochlorines by Chromatography, NMR, and Mass Spectrometry ......................... 77
   a. Column, Paper, Thin-layer, and Gas-liquid Chromatography ... 77
   b. Modern Physical Methods ...................................... 82

4. Bioassay .......................................................... 83

### Chapter 3
**Insecticides of the Diene-organochlorine Group** ............... 85

**A. Introduction** .................................................. 85

1. The Diels-Alder Reaction ......................................... 85

2. The Nomenclature of Cyclodiene Insecticides .................... 87

**B. Synthesis and Chemistry** ....................................... 99

1. Hexachlorocyclopentadiene and Its Self-condensation products; Chlordecone (Kepone®), Despiron®, Mirex, and Pentonic® ............. 99

2. The Diels-Alder Reaction with Hexachlorocyclopentadiene and Its Relatives ......................................................... 105
   a. Alodan®, Endosulfan, Isobenzan, Heptachlor, Chlordane, and Analogues ......................................................... 105
   b. Aldrin, Dieldrin, Isodrin, Endrin, and Related Compounds .... 113

3. Synthesis of Radiolabeled Cyclodiienes .......................... 117

4. Constitution and Chemical Reactions of Cyclodiienes ........... 123
   a. Configuration of the Ring Systems .............................. 123
   b. Heptachlor, Chlordane, and Related Compounds ............... 124
   c. Isobenzan and Endosulfan ..................................... 131
   d. Aldrin and Dieldrin ............................................ 132
   e. Isodrin and Endrin ............................................. 136
C. History and Development of the Commercial Cycloidiene Insecticides

1. Chlordane and Heptachlor
   a. Origins, Physical Properties, and Formulations
   b. Applications in Agriculture and Public Health
   c. Principles of Analysis

2. Endosulfan and Isobenzan
   a. Origins and Physical Properties
   b. Applications of Endosulfan
   c. Analysis of Endosulfan

3. Aldrin, Dieldrin, Isodrin, and Endrin
   a. Origins and Physical Properties
   b. Formulations and Early Evaluation
   c. Applications in Agriculture and Against Pests Affecting Man and Animals
   d. Principles of Analysis
   e. Current Status of Aldrin, Dieldrin and Endrin

4. Applications of Chlordecone (Kepone), Mirex, and Pentac

Chapter 4
Gamma-1,2,3,4,5,6-Hexachlorocyclohexane
A. Origins, Preparation and Physical Properties
   1. Applications in Agriculture and Against Pests Affecting Man and Animals
   2. Stereochemistry, Constitution and Reaction
   3. Analysis

Chapter 5
Polychloroterpene Insecticides [Toxaphene]
A. Origins, Preparation, Physical Properties
   B. Applications in Agricultural and Against Insects Affecting Man and Animals
   C. Analysis

References
Systematic Names Index
General Index