

PESTICIDES IN DOMESTIC WELLS



by Chittaranjan Ray

*Published by the
American Society of Agricultural Engineers
in collaboration with the Water Resources Research Center
University of Hawaii at Manoa*

Contents

1	Introduction	1
	Ground Water as a Resource	1
	Ground-Water Use	2
	Pesticides in Ground Water	5
	Objectives and Approach	7
	References	7
2	National-Scale and Multistate Studies	9
	National Pesticide Survey	9
	Study Design	10
	Implementation of the survey	14
	Sample-collection procedure	15
	Analytical methods	16
	Results	19
	National Alachlor Well Water Survey	22
	Midcontinent Herbicide Initiative	27
	Ciba Survey of Atrazine and Its Metabolites in Well Water	34
	Other Multistate Studies	39
	References	40
3	State-Level Studies	43
	United States	43
	California	43
	Colorado	44
	Illinois	46
	Iowa	54
	Kansas	61
	Minnesota	63
	Missouri	70
	Nebraska	73
	North Carolina	76

	Texas	80
	Wisconsin	83
	Canada	88
	Ontario	88
	Prince Edward Island	90
	References	91
4	Factors Contributing to Pesticide Occurrence in Domestic Wells	95
	Design of the Study	95
	Hydrogeologic and Soil Factors	98
	Land Use and Cultural Factors	103
	Intensity of Agricultural Activity	106
	Climatic Factors	107
	Well Factors	108
	Sampling and Analytical Factors	113
	Pesticide Properties and Application Methods	114
	References	118
5	Toxicological Issues	127
	Toxicological Considerations	127
	Pharmacokinetics	128
	Dose-Response Studies	130
	Health Advisories	132
	Noncarcinogenic and Carcinogenic Effects	133
	Noncarcinogens	133
	Assessment of noncarcinogenic risk	134
	Carcinogens	137
	Assessment of carcinogenic risk	137
	Models	139
	Mixed Exposures (synergetic and antagonistic effects)	139
	Ecotoxicological Issues	141
	The Issue of Metabolites	142
	Drinking Water Standard and Health Advisories	144
	References	144
6	Technological Issues	149
	Removal Mechanisms at the Point of Treatment	149

Removal Mechanisms at the Point of Use	150
Design Considerations	152
Reverse Osmosis	152
Activated Carbon Filters	153
Implications of Using Removal Units at the Point of Consumption	157
References	157
7 Sustainability Issues and Modification in Agricultural Practices	159
Relationship Between Pesticide Use and Chemical Detection in Surface/Ground Waters	159
Pesticide Application and Yield	160
Application Methods	160
Pre-emergent versus post-emergent application	160
Split versus single application	161
Incorporation versus placement	162
Formulation Effects	163
Delivery Method	164
Rate of Application	164
Farming Methods to Reduce Potential Loss of Pesticides to Ground Water	164
Structural and Nonstructural Measures at the Farm Scale to Reduce Water Quality Problems	165
References	166
8 Legislative Issues and Updates	169
Legislation on the Use of Highly Leachable Compounds	169
Basis for Compound Selection	170
Chemical Properties and Use	170
Risk Assessment	171
State Management Plan Components	173
Overviews of Selected State SMPs	175
Major Issues	177
Legislation on the Health-Based Tolerance Limits for Pesticides	178
References	180
9 Future Directions	181
<i>Index</i>	<i>185</i>