MONITORING OF FARM-SCALE BIOREMEDIATION SYSTEMS FOR PESTICIDE HANDLING/ WASHDOWN AREAS

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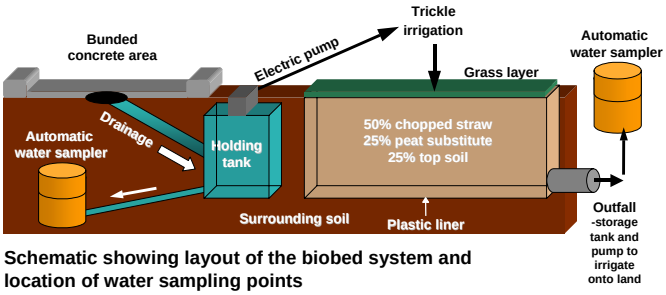
Introduction

A number of studies have indicated that a significant proportion of pesticide contamination of surface and ground waters arises from farmyard operations. A range of measures including enhancements to packaging design and application technology are aimed at reduction in emissions from this source. One possible approach is to use a biobed to intercept and treat contaminated runoff from washing down application machinery, and/or drips and spillages arising during the filling process. The biobed operates by providing enhanced environmental conditions for the retention of pesticides; followed by preferential degradation by thriving microbial populations.



Schematic showing layout of the biobed system and location of water sampling points

Design and monitoring

An on-farm biobed has been in operation in Lincolnshire, UK since spring 2002. The system uses a separate concrete washdown area, and a lined biobed containing biomix fill (comprising composted peat substitute, straw and topsoil). Runoff water from the concrete area is evenly distributed over the entire biobed area by a simple drip irrigation system. Treated leachate is disposed off to an adjoining grassed area, also using drip irrigation (subject to UK Environment Agency ground water authorisation).

The effectiveness of the system in retaining/degrading pesticide is monitored by taking samples from the holding tank below the bunded area (untreated runoff), as well as from the biobed outfall (treated leachate).

Test applications

The simulated contamination sources had extremely variable volumes and concentrations depending on the individual pesticides and their product label application rates

The bioremediation system was extremely effective in retaining and/or degrading the initial test pesticides. Typically, the severe input concentrations were reduced by 10,000 to 100,000 fold. 87% of the >1100 individual determinations from the discharge leachate samples had a concentration <0.5μg/litre, with many below 0.1μg/litre.

Maximum Concentrations (μg/L) Detected in Runoff/Leachate following test applications

Compound	Concrete intercept to biobed	
	Before biobed	After biobed
Dimethoate	44,250	0.9
Chlorothalonil	97,000	0.3
Isoproturon	141,000	<0.5
Chlorpyrifos	77,600	0.7
Pendimethalin	205,500	2.3
Epoxiconazole	9,100	0.8

Usage

In addition to normal farm use, the system was initially tested by artificially contaminating the bunded concrete pad with a suite of commonly used pesticides of differing physico - chemical characteristics. The concentrations and volumes used aimed to exceed the levels expected during normal farm operations. Following these test applications, the biobed has been in routine commercial use for a further two seasons.

Summary of products and active ingredients in use over the monitoring period Mar - Oct 2004

Product	Active Ingredient	Amount Used
Contest	Alpha-cypermethrin	20.2 kg
Delsene	Carbendazim	110.8 L
Contrast	Carbendazim + flusilazole	69.6 L
Chlormeqat 720	Chlormequat	110 L
Laser	Cyclodim	22.5 L
Epic	Epoxiconazole	25 L
Sumi-Alpha	Ethofumesate	20 L
Roundup Max	Glyphosate	229 kg
Atlantis	Iodosulfuron-Methyl-Sodium + Mesosulfuron-Methyl	50 kg
Katamaran	Metazachlor + Quinmerac	186 kg
Trifluralin	Trifluralin	200 L
Permasect	Cypermethrin	22.5 kg
Crystal	Flufenacet + Pendimethalin	328 kg

Commercial Use

Compounds chosen for analysis were based on actual farm use patterns. Initial monitoring results have suggested the effectiveness of the biobed in reducing pesticide concentrations in runoff has continued during routine farm use. Concentrations in biobed leachate were highest for more mobile compounds such as Metazachlor (maximum recorded concentration in leachate of 77 μg/litre compared to 3914μg/litre in the initial runoff during spring 2004). In contrast, concentrations of Carbendazim were reduced from a maximum of 1893 μg/litre in initial runoff to less than the detection limit in biobed leachate.

Maximum Concentrations (μg/L) Detected in Runoff/Leachate - Spring/Summer 2004

Compound	Concrete intercept to biobed	
	Before biobed	After biobed
Metazachlor	3,914	77.0
Epoxiconazole	1,175	4.5
Flusilazole	1,225	<0.5
Trifluralin	30.9	<0.5
Carbendazim	1,893	<0.5

Conclusions

On-farm bioremediation systems can limit point source pesticide pollution derived from farmyard operations. Environmental conditions in the bioremediation systems provided enhanced opportunities for pesticide retention and/or degradation. Careful water management, together with an annual biomix top-up, should maintain the effectiveness of bioremediation systems for a number of years

Further work

Monitoring of inputs/output from the biobed system is continuing in order to quantify effective life of the biomix fill.

Acknowledgements

The work was funded by the UK Environment Agency, the Department for Environment, Food and Rural Affairs, the Scotland and Northern Ireland Forum For Environmental Research, and the Lincolnshire Agricultural Machinery Manufacturing Association.