



PROJECT

Bioremediation of DDT, DDE, and Dieldrin

Site: 240-Acre Future Residential Development Site,
Ontario, Canada – Confidential Client

SUMMARY

A future residential development was to be built on land that had concentrations of organochlorinated pesticides such as DDT, DDE, and Dieldrin that exceeded the residential use standards. To save money and help the environment compared to excavation and off-site disposal (dig and dump), the developer contracted PeroxyChem to apply its patented DARAMEND® treatment process on site (**Fig. 1**) to destroy these contaminants. A successful two-acre pilot project was completed in late 2006. By early September 2007, four months after kick-off, the full-scale remediation of an additional 32 acres of soil was completed on time and on budget. The guaranteed fixed-price cost of this turn-key project was less than US\$35,000 per acre (less than \$21 per ton). Compared to a theoretical cost of dig and dump of \$100/ton, the savings on the project would be over \$79/ton. The approach resulted in savings of over \$4 million compared to the dig and dump estimate.



Figure 1: DARAMEND treatment on site.

THE CHALLENGE

A former agricultural site (**Fig. 2**) was being converted to residential use. However, application of pesticides over many decades to the upper 0.5m of apple trees and strawberry plants resulted in Dieldrin, DDT and DDE residual concentrations that exceeded the standards for residential use.

A total of approximately 34 acres of land exceeded the standards on this 240-acre site. The impacted areas included ten fields across the site. The fields were divided into approximately 1-acre plots for the purpose of tracking treatment progress.

PERFORMANCE WARRANTY

Given the successful prior work on this and other similar sites, PeroxyChem provided a performance warranty for the full-scale work. With the exception of a mobilization fee, no payment would be retained unless the soil met the treatment standards. This warranty structure removes substantial risk from the client's perspective.





FIELD WORK

DARAMEND treatment of organochlorine pesticides such as DDT, DDE, DDD, Dieldrin, Toxaphene, Chlordane, and many others requires a treatment approach where the soil is cycled between reducing conditions and aerobic conditions. The DARAMEND amendment (**Fig. 3**), which in this case was a combination of controlled-release carbon and zero-valent iron, was spread onto the soil and incorporated using specialized rotary tillers (**Fig. 4**).



Figure 3: DARAMEND 1-ton bags.



Figure 4: Incorporation of DARAMEND into soil using specialized tillers.

Once incorporated into the soil, water is added to achieve the desired moisture content (**Fig. 5**). This step initiates the reductive phase of the treatment. Native microorganisms in the soil utilize the carbon and nutrients provided by

the DARAMEND to drive the oxidation reduction potential (ORP) down. Corrosion of the iron, as intended, further reduces the ORP. This combination of processes creates an environment where chlorine atoms are removed from the pesticides. After the reductive phase, the soil is tilled again to dry out the soil to a lower moisture content and introduce oxygen into the soil. This allows further breakdown of the organic pesticides and prepares the soil for further treatment cycles if necessary. In this case, only one or two treatment cycles were required per plot.



Figure 5: Irrigation of soil at 300 gallons per minute.



THE RESULT

The results of the treatment are summarized in Tables 1a) and 1b) for DDT, DDE, and Dieldrin. For plots that were treated in one cycle, the average percentage removal ranged from 38% to 53%. For plots that required two treatment cycles, the average percentage removal was between 65% and 68%. Although DDD did not exceed the remedial standards, it was reduced by an average of 57% in one treatment cycle.

Tables 1a) and b): Influence of DARAMEND treatment on DDT, DDE, and Dieldrin in soil. Data provided are average values, calculated using plots that were treated after one treatment cycle (**Table 1a**) and after two treatment cycles (**Table 1b**). Constituent data that were below standards at the beginning of treatment were not included in calculations.

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1a)

Constituent	Initial Concentration (mg/kg)	Concentration After 1 st Cycle (mg/kg)	Final % Removal
DDT	1.90	0.98	49%
DDE	2.38	1.11	53%
Dieldrin	0.064	0.040	38%

1b)

Constituent	Initial Concentration (mg/kg)	Concentration After 1 st Cycle (mg/kg)	Concentration After 2 nd Cycle (mg/kg)	Final % Removal
DDT	2.05	2.00	0.66	68%
DDE	2.37	1.98	0.80	66%
Dieldrin	0.110	0.080	0.028	65%

THE CONCLUSION

The remedial standards were met for 100% of the plots within a period of four months, at a cost of less than US\$ 35,000 per acre (\$21 per ton). With savings of potentially more than \$79/ton, savings can quickly accumulate into millions of dollars. With the added security of a performance -based fixed-price warranty, the DARAMEND technology offers significant advantages to clients seeking to remediate lands contaminated with chlorinated pesticides.

In addition, the treatment method is very environmentally sound. The soil is treated on site as opposed to using landfill space. The process uses little energy and very few resources. Finally, contaminants are destroyed, not just transported for storage or treatment elsewhere.