Bull. Environm. Contam. Toxicol. 23,123-128 (1979)

Use of Oil Sorbent Materials for Small Herbicide Spills

William S. Scott
Department of Transmission Environment,
Ontario Hydro, Toronto, Ontario, M5G 1X6, Canada

Use of herbicides to selectively control unwanted vegetation has become widespread in the maintenance of power transmission rights-of-way. Various techniques are used to apply herbicide sprays using water or oil as the carrier. Ontario Hydro (an electrical utility) uses an oil-herbicide spray mixture both as a basal spray to control brush, and also as a stump spray to prevent suckering of cut stumps. Materials used in this manner include 2,4,5-T or a 50-50 mixture of low volatile esters of 2,4-D and 2,4,5-T; which may be diluted with kerosene, Numbers 1 or 2 fuel oil, diesel fuel oil or strained waste transformer oil (ONTARIO HYDRO 1972).

A variety of oil sorbent materials are available for "mopping up" oil that has been spilled on water. The feasibility of using oil sorbent materials to soak up herbicide, as well as oil, in the event of spillage in a swamp or other wetland, was investigated in this study.

Available literature was searched and personal communication was made with representatives of the Ontario Petroleum Association and with 3M Corporation, a manufacturer of oil sorbent materials. Apparently, no testing had been done in this regard. It seemed likely that the herbicide would preferentially stay in the oil phase rather than migrate into the water phase in the event of the spillage of an oil-herbicide mixture in a wet area. In order to attempt to answer these questions, a controlled laboratory experiment was designed.

EXPERIMENTAL

A sample of oil-herbicide mixture consisting of approximately 0.4 pints of a 2,4-D/2,4,5-T 50:50 mixture of low volatile esters (Brushkil), mixed with one gallon of waste transformer oil was obtained.

To each of four glass containers with a surface area of 266 cm^2, 1.0 L of distilled water was added, followed by 10.0 mL of the oil-herbicide mixture.

0007-4861/79/0023-0123 $01.20

Exactly 2 min after the addition of the oil-herbicide mixture, pieces (6 x 8 cm) of oil sorbent sheets (3M Brand) were used to soak up all visible traces of the oil film. The remaining liquid in the container was then stirred vigorously and transferred to a glass bottle, and then kept in the dark until analysis for 2,4-D and 2,4,5-T was performed.

This same procedure was then repeated, but with a longer waiting period between the addition of the oil-herbicide mix and the application of the oil sorbent material. In addition to the 2 min interval, periods of 1, 3, 6 and 16 h were used (chosen mostly for convenience sake). For each time period, four replications were performed. During the waiting period the containers were left open to the air and in a room with incandescent lighting, with the exception of the 16-h period. During this period, the containers were in the light for about the first 4 h, then in the dark for about 10 h, and then in the light for the last 2 h. This was to represent an overnight situation where a spill occurred at about 1600 h but was not noticed until about 08:00 the next morning.

In addition, a set of four samples was run with a 2 min waiting period, but particulate sorbent material was used instead of sorbent sheets.

A blank sample was also run as follows. After a run of samples had been completed, the glassware was washed and 1.0 L of distilled water was added to the container but no oil-herbicide mixture was added. Unused oil sorbent sheet material was then applied as if the oil-herbicide mixture was present, and the water was then transferred to a sample bottle and kept in the dark.

All samples were taken to the Ontario Ministry of Agriculture and Food, Pesticide Residue Testing Laboratory and were analyzed for 2,4-D and 2,4,5-T acid content. In addition, a sample of the oil-herbicide mixture was also analyzed.

RESULTS AND DISCUSSION

The oil-herbicide mixture was analyzed and found to contain 0.077% 2,4-D and 0.055% 2,4,5-T. Therefore, when 10.0 mL of this mixture was added to 1.0 L of distilled water, the resulting suspension had concentrations of 7.6×10^3 ug/L 2,4-D and 5.4×10^3 ug/L 2,4,5-T.

Table 1 lists the concentrations of 2,4-D and 2,4,5-T that remained in the samples after being treated with the two different forms of oil sorbent material. Both treatments removed more than 97% of the 2,4-D and 98%

of the 2,4,5-T from the samples, with the sorbent sheets slightly more effective than the particulate form. Apparently, the herbicide was adsorbed, along with the oil, by the sorbent material and removed from the water samples. It is not known whether the herbicide was adsorbed directly by the material or whether it was removed only because it was mixed with the oil.

TABLE 1

Concentration (ug/L) of remaining 2,4-D and 2,4,5-T after treatment with two forms of oil sorbent material.

Treatment	2,4-D		2,4,5-T	
		mean		mean
Sorbent Particulate*	155	148	52	46
	144		32	
	105		35	
	187		64	
Sorbent Sheets*	79	85	33	36
	83		35	
	90		42	
	87		33	
Control Sample	4		4	

*Sorbent materials applied 2 min after addition of oil-herbicide mixture.

A number of other samples were treated with sorbent sheets, but variations in the length of the time period between the addition of oil-herbicide mixture and the application of the sorbent sheets were investigated. Table 2 lists the concentrations of 2,4-D and 2,4,5-T that remained in the samples after the various treatments.

TABLE 2

Concentrations (ug/L) of remaining 2,4-D and 2,4,5-T after various treatments with oil-sorbent sheets.

Treatment	2,4-D		2,4,5-T	
		mean		mean
Control Sample	4		4	
Sorbent Application After Two Minutes	79	85	33	36
	83		35	
	90		42	
	87		33	
Sorbent Application After One Hour	270	260	120	120
	280		140	
	270		140	
	200		90	
Sorbent Application After Three Hours	540	590	200	260
	610		250	
	580		270	
	650		320	
Sorbent Application After Six Hours	650	740	270	310
	760		310	
	740		300	
	820		360	
Sorbent Application After Sixteen Hours	810	920	350	390
	860		380	
	970		410	
	1050		440	

The mean values for each treatment are significantly different, and increase in value (but in diminishing increments) as the time delay before sorbent application increases. This trend is further illustrated in Figure 1. With just a 2 min delay between herbicide application and use of the sorbent, only 85 ug/L 2,4-D and 36 ug/L 2,4,5-T remained in the sample. As the time delay before the use of the sorbent increased, less herbicide was picked up with the sorbent, and more remained in the sample.

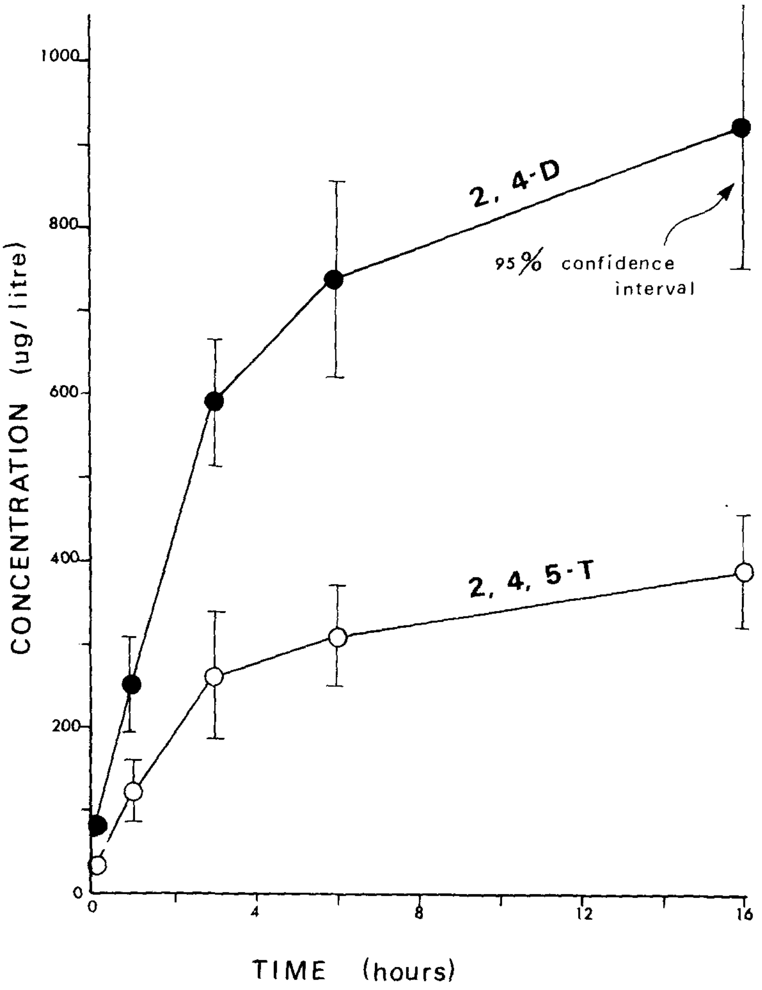

Figure 1. Concentration of remaining 2,4-D and 2,4,5-T as a function of time before sorbent application.

The maximum time delay tested was sixteen h; and with this period, 920 ug/L 2,4-D and 390 ug/L 2,4,5-T remained in the sample after use of the sorbent sheets. These concentrations, although considerably higher than the values for the 2 min delay, are only about 12% and 7% respectively, of the concentrations in the samples before sorbent application.

Although longer time periods were not investigated, Figure 1 suggests that the time-concentration curves appear to be levelling off, and that a time will be reached when no further increase in remaining concentrations (or decrease in amount recovered from the water) occurs.

In conclusion, under the conditions of this experiment oil-herbicide mixtures can be mopped up from water surfaces with the use of oil sorbent materials. As much as 98% of the herbicide can be recovered if sorbents are used quickly after a spill occurs, but as time elapses between spillage and sorbent application, less herbicide is recovered. Nevertheless, even after a 16-h delay, as much as 88% of the herbicide was recovered with the use of sorbent sheets.

It must be cautioned that this was a controlled laboratory experiment and that actual field performance of the sorbent material may be affected by a number of other factors. For example, in a wetland area, a spilled oil-herbicide mixture would be in close contact with organic matter (both suspended in and protruding through the water) and may quickly adhere to it, thereby reducing the efficiency of the sorbent material. Also, experimentally the herbicide mixture was confined to a small container, but in actuality the spilled mixture would be unconfined and would spread over the water surface making recovery much more difficult.

In this study, a mixture of waste transformer oil and herbicide was examined, this being only one of several oil carriers currently in use. Mixtures of herbicides with other oil carriers would probably behave in a similar manner, although the efficiency of the sorbent material could vary with each oil used. Future studies could be to investigate the capacity of this material to adsorb other oils that are used with herbicides. The effectiveness of the sorbent material should also be tested in an actual field situation.

REFERENCES

ONTARIO HYDRO: "Chemical Control of Vegetation, Insects and Fungi", Ontario Hydro, Specification No. L-167-72, Toronto, Ontario (1972).