Journal of Conventional Weapons Destruction

Volume 7
Issue 3 *The Journal of Mine Action*

Article 22

October 2003

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Issue 7.3, December 2003
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REST in Bosnia: A Pilot Test of Detection Capability

The following report discusses the results of a pilot study designed to investigate the possibility that Remote Explosive Scent Tracing (REST) technology can be used for area reduction in Bosnia-Herzegovina.

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Introduction

REST is the concept of transferring a target odor to an animal detector using a filter.[1, 2, 3] The vapor sample is made at the suspect site by vacuuming air through the filter. Testing of the filter by the detector is undertaken in a laboratory environment, and involves a number of internal controls to ensure reliability.

REST was originally conceived by Mechem in South Africa and was used operationally for mine detection through the early to mid-1990s.[4] Unfortunately, little documentation is available on the original research of its development. Despite its apparent success as an efficient technology for area reduction, it was not embraced by the mine clearance industry. Mechem has always maintained a small capacity for REST detection, called the Mechem Explosive and Drug Detection System (MEDDS), and the technology has been developed by a small number of other agencies, with varying success and capacity. Several agencies in Europe are testing it for applications other than mine detection under a variety of names.

The Geneva International Center for Humanitarian Demining (GICHD) has initiated a broadly based program of research on mine detection animals[5] that should further develop the potential of REST technology. In this report, we review a pilot study designed to determine whether REST technology can be used for effective area reduction in Bosnia-Herzegovina. Due to cool temperatures, heavy soils and wet summers, it is believed by mine clearance operators that mine detection by field dogs is relatively difficult in Bosnia, compared to countries with dryer climates and sandy soils.[6] As field dogs and REST technology both depend on the availability of explosive vapors in the minefield, it seems likely that similar difficulties will apply to the use of REST in Bosnia. We also used the pilot study to investigate a number of related factors that potentially influence the detectability of mines on filters.

Methods

The study used test minefields previously established by Norwegian Peoples Aid (NPA) near Sarajevo and Mostar. Thus, all mines used had been in the ground for long periods of time (up to several years). The fields were established in grazing land or on sites subject to a variety of historical disturbances typical of the perimeter of a city, such as contamination from garbage and other industrial wastes.

Except for treatment variables, all aspects of sampling were standardized. The sampler operated a petrol-powered pump connected to a 1.5-m tube that was passed back and forth over the ground. The filter was placed in the end of the tube, and all vacuumed air passed through the filter (or filters, if two were being produced at one time). The sampling team consisted of two people who alternated the roles of operating the pump and maintaining records and assigning filters. The treatment variables were as follows:

- When the machine encountered the mine (start, middle and end of the 60-second sampling period)
- Total time filter was held over the mine (pass only, one second, two seconds and five seconds)
- Weather variation (recorded at the time of sampling)
- Type of mine sampled (three)

The following factors were to be held constant:

- Total sampling time (60 seconds)
- Sampling vacuum rate (60 litres/minute passing through the filter)
- Depth at which the mine was laid (within 10 cm of the surface)
- Equipment (a small petrol-drive vacuum machine and the standard Mechem filter)
- Sampling procedure (the operator walks slowly forward, passing the vacuum nozzle back and forth across the ground)
- Number of mines sampled onto one filter (one)
- Testing (all filters tested with four dogs)

At the same time as the treatment filters were made, 20 neutral or negative filters were also made in explosive-free areas near to the minefield.

The sampling procedure involved the operator using a mine on the edge of the test field and walking either towards or away from the mine, in order to encounter it at the required sector of the 60-second sampling interval (beginning, middle and end). Weather factors recorded at the time of sampling were temperature and humidity at chest height. The temperature gauge was not shaded. All sampling was done in light winds or calm conditions, and at least 24 hours after heavy rain.

The following two measures for probability of detection were available:

1. The proportion of "positive" filters that were detected
2. The proportion of dogs that detected each "positive" filter

Each dog was given one opportunity to detect a filter, although on some runs it could pass the filter twice because of the circular array presentation (see Fig. 1). Most presented analyses use values from the second, more sensitive, measure.

Figure 1: Circular array presentation of the filters. Dogs were trained to circle the array once, but some overlap at the start and end of the circle sometimes occurred. During testing, the array presented 12 filters.

Details of the testing procedure are described in Fjellanger1 and Fjellanger et al.[7] In summary, 12 filters were placed on the choice array by a technician using sterile procedures. One (or zero for a negative run) test filter was placed among 11 negative filters. The dog was then led into the test room. It was trained to circle the array in one direction, sniffing each filter as it passed. The dog indicated a positive by stopping and/or sitting at that filter. Only clear indications were accepted. The dogs were given no assistance during testing trials as personnel in the testing room stood behind blinds while testing occurred. All testing used three personnel: a dog handler, a recorder and a technician who dealt with the filters. All personnel worked in each role at different times. The dog handler and recorder were blind for the origin of each filter, and the technician (who assigned filters) left the room during testing. However, the technician was also blind because no information on the sampling identity of each filter was provided from Bosnia until all testing was completed.

It was assumed that all of the four dogs were working at equivalent detection sensitivity and capability. Internal checks using known positives and negatives tested for reliability. A "miss" is a filter that is supposed to be positive but is not indicated by a dog. A "false alert" is a filter that is supposed to be negative but is indicated by a dog as positive.

Results

Overall, 60 of 88 positive filters were found (68 percent). Detection was significantly more successful for filters from Mostar (72 percent) than Sarajevo (53 percent) (X2 = 5.25, P = 0.02; data lumped for the number of dogs finding the positive filter; see Table 1). Temperatures at the time of sampling were generally higher at Mostar than at Sarajevo (see "Weather Variables" below).

No Dogs	0	1	2	3	4
Mostar	13	3	10	12	18
Sarajevo	15	5	10	0	2

Table 1: Number of positive filters found by four dogs at two locations in Bosnia. Zero dogs means that the filter was missed by all dogs.

Treatment Variables

No significant effects were found for the following:

- Position in the 60-second sampling period (beginning, middle or end; X25 = 0.79)
- Whether the sampling nozzle passed over, or paused over, the mine (pass, one second, two seconds and five seconds; X2 = 0.07; one, two and five lumped for this analysis)
- Type of mine (PMA3, TMA4 or TMM1; see Table 2). The find rate for TMM1 mines was lower than for the other two types, but N was small, and TMM1 mines were only sampled at Sarajevo where the overall find rate was lower.

No Dogs	0	1	2	3	4
PMA	10	3	6	8	9
TMA	12	4	13	4	11
TMM	6	1	1	0	0

Table 2: Number of positive filters found by four dogs in relation to type of mine.

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