paper, polyester/cotton fabric and polyurethane foam with activated charcoal. The size of the samples and the amount of agent were the same as during the first exercise. Analysis was carried out after two and four weeks.

Sample handling

The possibility of achieving a positive verification will inter alia depend on the conditions for handling and transporting samples. A separate exercise has therefore been carried out to evaluate the influence of various temperatures during the transport of headspace vials. Temperatures of +20, 0 and -20°C were chosen, simulating room temperature and the approximate temperatures of a refrigerator and of a freezer respectively. As in the second field trial, 5 different chemical agents and 10 different sample materials were used in the experiment. The various samples were spiked with 1 mg of each agent. The headspace vials were immediately sealed with the appropriate stopper and stored for 24 hours under the various temperatures. They were then analysed according to standard procedure.

Analytical method

A screening method to be used on samples suspected of containing one or more of the chemical agents tabun, sarin, soman, mustard gas and diisopropyl methylphosphonate has been developed. The optimal method for each of the agents depends on the agent, the sample matrix, the thermostatting time and temperature as well as on the standard gas chromatographic conditions. The gas chromatogram was recorded with a Carbowax 20M column and a flame ionization detector with a temperature programme starting at 140°C for 2 minutes, rising by 10°C/minute to 160°C, and continuing at this temperature for 6 minutes. The samples were thermostatted in the heating block at 100°C for 12 minutes.

Results

The results of the field exercise under winter conditions, in which sarin and soman were used, clearly show that headspace gas chromatography can be a valuable method in verification of alleged use of chemical warfare agents. How much of the agent is detected depends both on the agent and on the type of sample it is recovered from. The amount of agent recovered seems to decline very rapidly during the first 2-5 days of outdoor exposure, but after that the deterioration is much slower. As expected, the amount of sarin declined faster than the amount of soman. After 7 days, the recovery in percentage of applied amount of sarin varied from 0 in polyester/cotton fabric and butyl rubber to 6.5 in pulyurethane foam with activated charcoal. After 14 and 28 days, sarin was found only in silicone (0.3 per cent and 0.02 per cent) and polyurethane foam (3.3 per cent and 0.8 per cent). Soman was recovered in all samples after 7 and 14 days in percentages of applied amounts ranging from 0.2 to 27.8 after 7 days and from 0.02 to 15.6 after 14 days. After 28 days soman was detected in all samples except water in percentages varying from 0.04 to 6.0. Silicone gave the best results for soman in all these periods, while polyester/cotton fabric and water gave the poorest results. Both sarin and soman were recovered in silicone and polyurethane foam with activated charcoal, which indicates that polymers such as these are preferable as sample materials in verification of alleged use of chemical warfare agents.