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MOLOTOV COCKTAILS AND SIMILAR DEVICES USED BY TERRORISTS IN ISRAEL

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ABSTRACT

During the last few years there has been a great increase in the use of home-made improvised explosives and combustible materials by terrorists in Israel. The most common device is a bottle containing an inflammable liquid and an ignition mechanism. We define such a bottle (often called a "Molotov Cocktail") as an "incendiary bottle". The composition of the inflammable liquid is determined by our laboratory and each of its components identified. The results serve as court evidence as well as to connect between cases during the investigation. In this paper several examples of incendiary bottles encountered recently by our laboratory are described.

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INTRODUCTION

During the last few years there has been a significant increase in the use of home-made improvised explosives and combustible materials by terrorists in Israel. The most popular device is called by us "incendiary bottle". It is often known in the literature as "Molotov Cocktail", fire bottle or fire bomb.[1,2] The following numbers demonstrate the increasing use of incendiary bottles in Israel: in 1981 we handled in our laboratory 28 cases involving incendiary bottles while 244 such cases were handled in 1985. This constitutes an increase of 870% within 4 years.

In the case of incendiary bottles, the forensic chemist's task is to identify the chemicals used to prepare these bottles and if possible to determine their composition. Often the exhibits received in the laboratory include no more than a few pieces of broken glass. The amount of information gained in such cases is obviously limited but in many of these cases the residues of the inflammable material are identified. When the exhibits include unused bottles there is much more information to be gained. An important point during an investigation is based on the assumption that identical composition may serve as a link between different cases.

In this paper some examples of incendiary bottles with different mechanisms and various chemical compositions are discussed.

EXPERIMENTAL

Gas chromatographic analyses of the inflammable liquids were carried out on a Varian 3700 gas chromatograph, equipped with a flame ionization detector (FID). The chromatographic column was a 6 m X 1/8 in. stainless steel tubing packed with 5% OV 101 on Chromosorb W. The column temperatures were programmed from 50°C to 230°C at 8°C/min. Injector and detector temperatures were 250°C and 300°C, respectively. The carrier gas (nitrogen) flow was 10 ml/min.

RESULTS AND DISCUSSION

We define an "incendiary bottle" as a bottle which contains an inflammable liquid and has an ignition device. The common inflammable liquids are gasoline, kerosene and some other mixtures of various petroleum products. Gasoline is the most popular liquid. It is often mixed with heavier petroleum products such as kerosene, diesel oil or even mineral motor oil.

Two types of ignition mechanisms are popular. The first, shown in Figure 1, has a fabric string - a wick - inserted through the bottle neck. The second, shown in Figure 2, consists of a rag saturated with the inflammable liquid and wrapping the bottle neck. The user ignites the wick or the rag and throws the bottle towards the target.

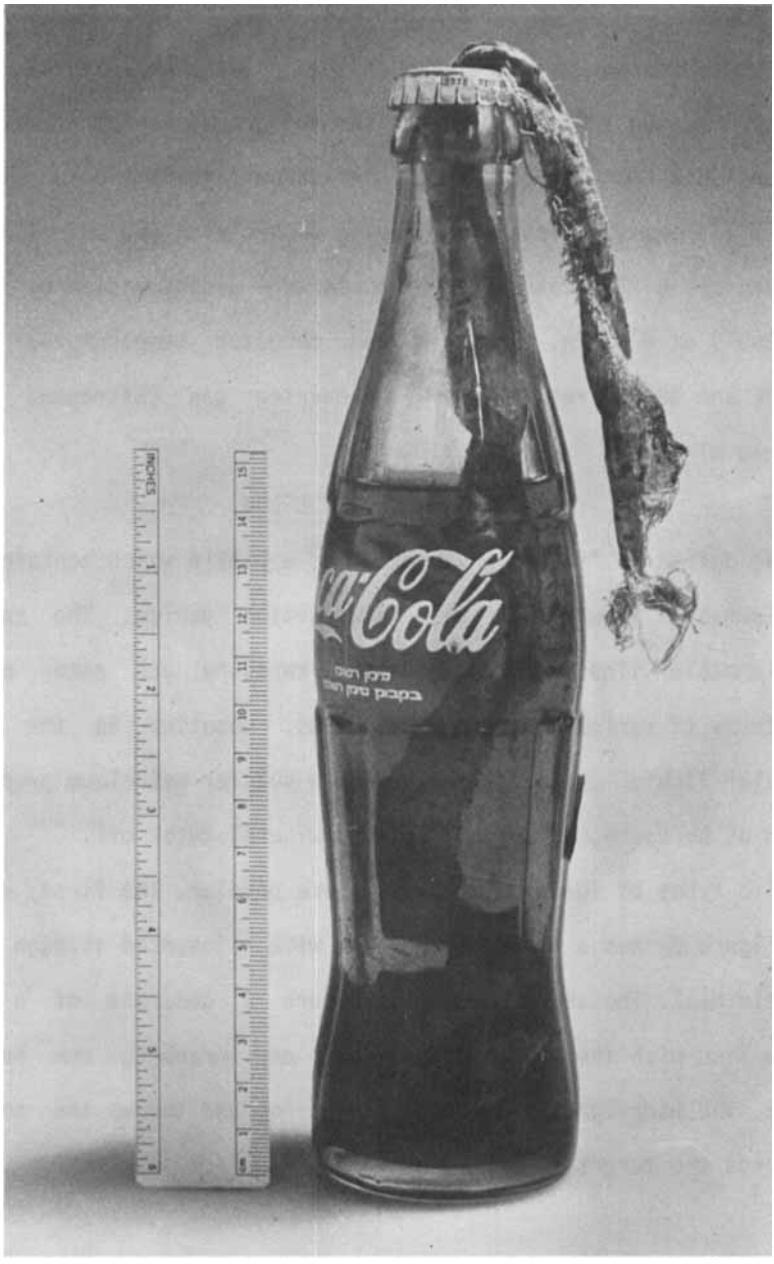

FIGURE 1
Ignition mechanism based on a wick inserted through the bottle neck.

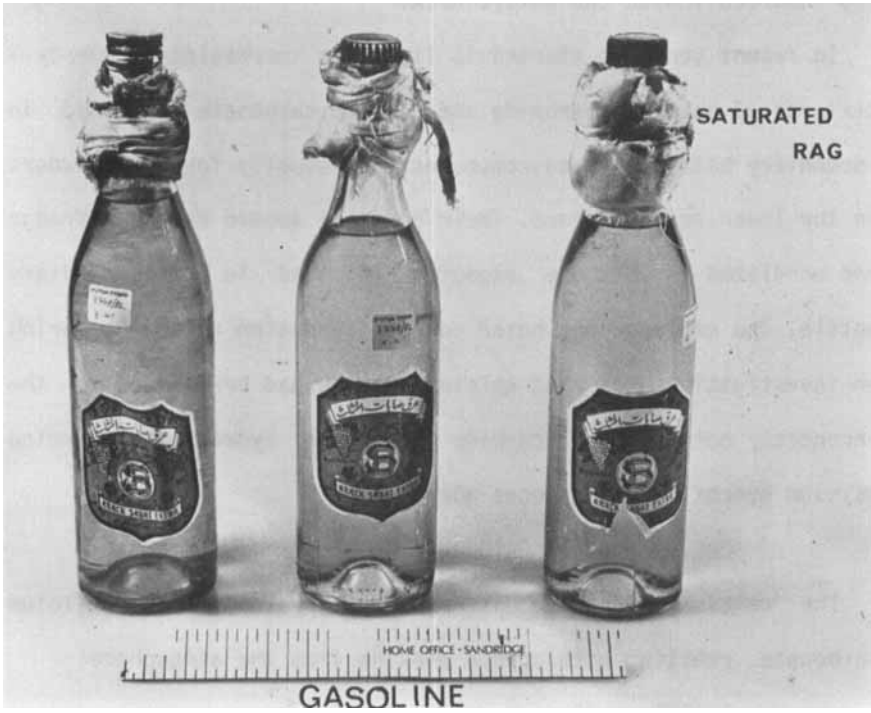

FIGURE 2
Ignition mechanism based on a rag, saturated with the inflammable liquid, wrapping the bottle neck.

Another type of an ignition system, described by us as a "crown of matches" is shown in Figure 3. The matches are tied with a cellotape around the bottle neck. In a somewhat different version, shown in Figure 4 , a group of matches is tied together and inserted inside the bottle neck.

In recent years we started to find-with increasing frequency - mixtures of calcium hydroxide and calcium carbonate contained in incendiary bottles. These compounds were usually found as powders in the lower aqueous phase. Their presence seemed rather strange and unrelated to what one expected to find in an incendiary bottle. The explanation, based on an information received during an investigation, was that calcium carbide had been added to the incendiary bottle. The carbide undergoes hydrolysis, forming calcium hydroxide and gaseous acetylene:

$$CaC_2 + H_2O \longrightarrow Ca(OH)_2 + C_2H_2$$

The calcium hydroxide is converted slowly to calcium carbonate, reacting with carbon dioxide from the atmosphere:

$$Ca(OH)_2 + CO_2 \longrightarrow CaCO_3 + H_2O$$

The addition of calcium carbide powder to incendiary bottles is probably aimed to enhance explosive effects by the participation of gaseous acetylene in the process. This addition also makes the device more dangerous to the user. Figure 5 is an example of an unused bottle containing a mixture of gasoline and diesel oil as the inflammable liquid and also large amounts of calcium hydroxide and calcium carbonate.

FIGURE 3
A "crown of matches" - type ignition mechanism.

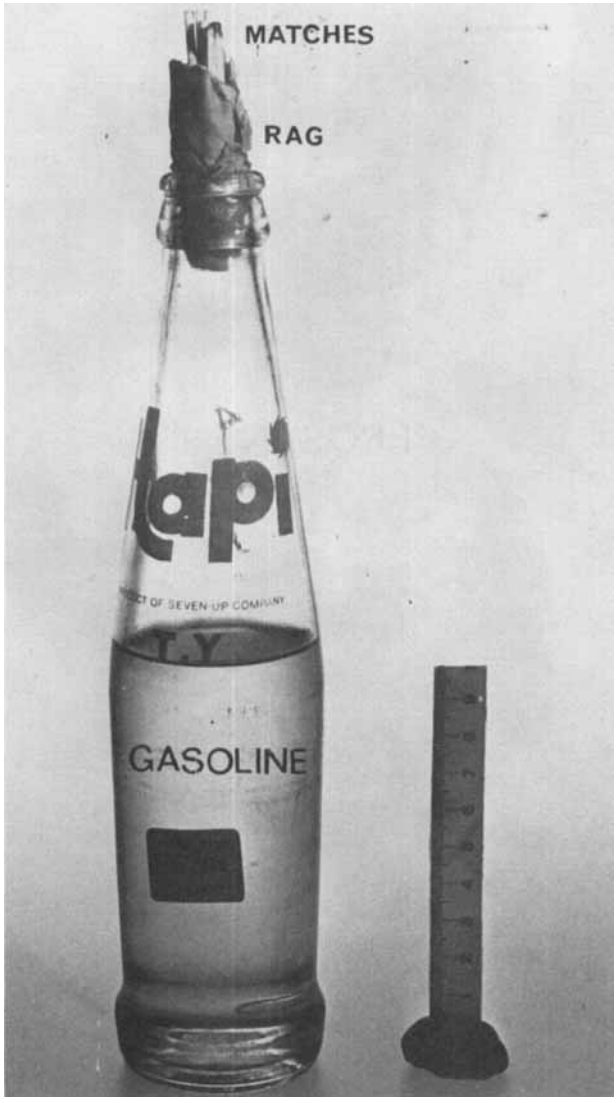

FIGURE 4
Ignition mechanism based on a group of matches tied together, inserted inside the bottle neck.

FIGURE 5
Incendiary bottles containing (in addition to the inflammable liquid) calcium hydroxide and calcium carbonate, presumably originating from calcium carbide.

An original "Molotov Cocktail" could be defined as an incendiary bottle containing a mechanism for self-ignition. Although this mechanism makes it more sophisticated than the normal incendiary bottles described above, it is still quite easy to prepare.[3] The ignition system in a "Molotov Cocktail" is typically based on the exothermic reaction between concentrated sulfuric acid and chlorate/sugar mixtures. Many variations of "Molotov Cocktail"-type devices exist, including devices which have a delay system.[4] Figure 6 shows a "Molotov Cocktail" device which was caught from a terrorist when he was preparing the device. It consisted of corduroy bag containing a mixture of granulated sugar and potassium chlorate in its bottom. The corduroy bag covered a bottle whose cap was a balloon - like rubber. The liquid in the bottle contained two phases: the lower phase (~ one third) was concentrated sulfuric acid and the upper phase (~ two thirds) was a mixture of gasoline and kerosene. The lower part of the bottle was surrounded with the chlorate / sugar mixture. The components of this "Molotov Cocktail" device are shown in Figure 7 and Figure 8. The ignition occurs at the moment of an impact with a hard surface and is followed by the highly exothermic reaction between the chlorate/sugar mixture and the concentrated sulfuric acid.

FIGURE 6
A "Molotov Cocktail"-type device, caught during its preparation.

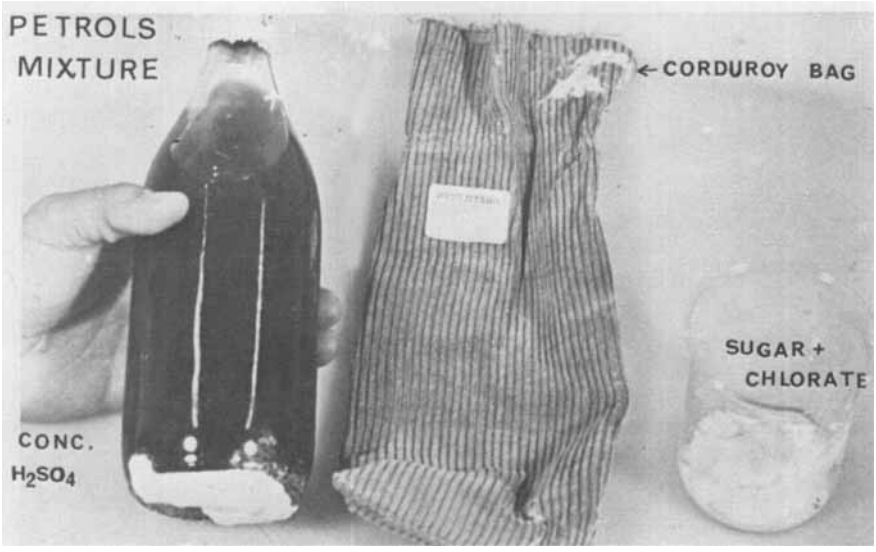

FIGURE 7
The components of the device in Figure 6: the corduroy bag containing chlorate/sugar mixture transferred into the beaker and the bottle containing sulfuric acid and inflammable liquid.

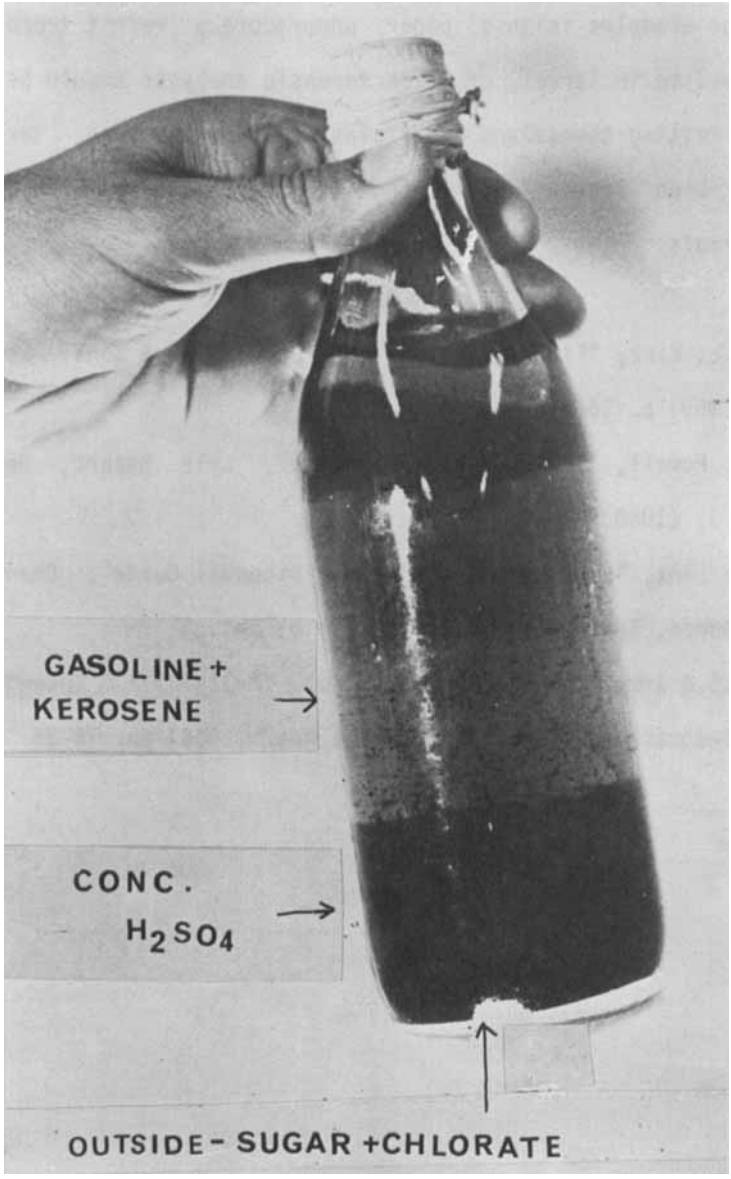

FIGURE 8
The bottle from the device in Figure 6. Inside: sulfuric acid and gasoline/kerosene mixture. Outside: part of the chlorate/sugar mixture.

CONCLUSIONS

The examples in this paper underscore a recent trend among terrorists in Israel, of which forensic analysts should be aware. Not limiting themselves to "classical" explosives, terrorists have been increasingly using devices based on inflammable materials.

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