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Explosives Vapor Detectors

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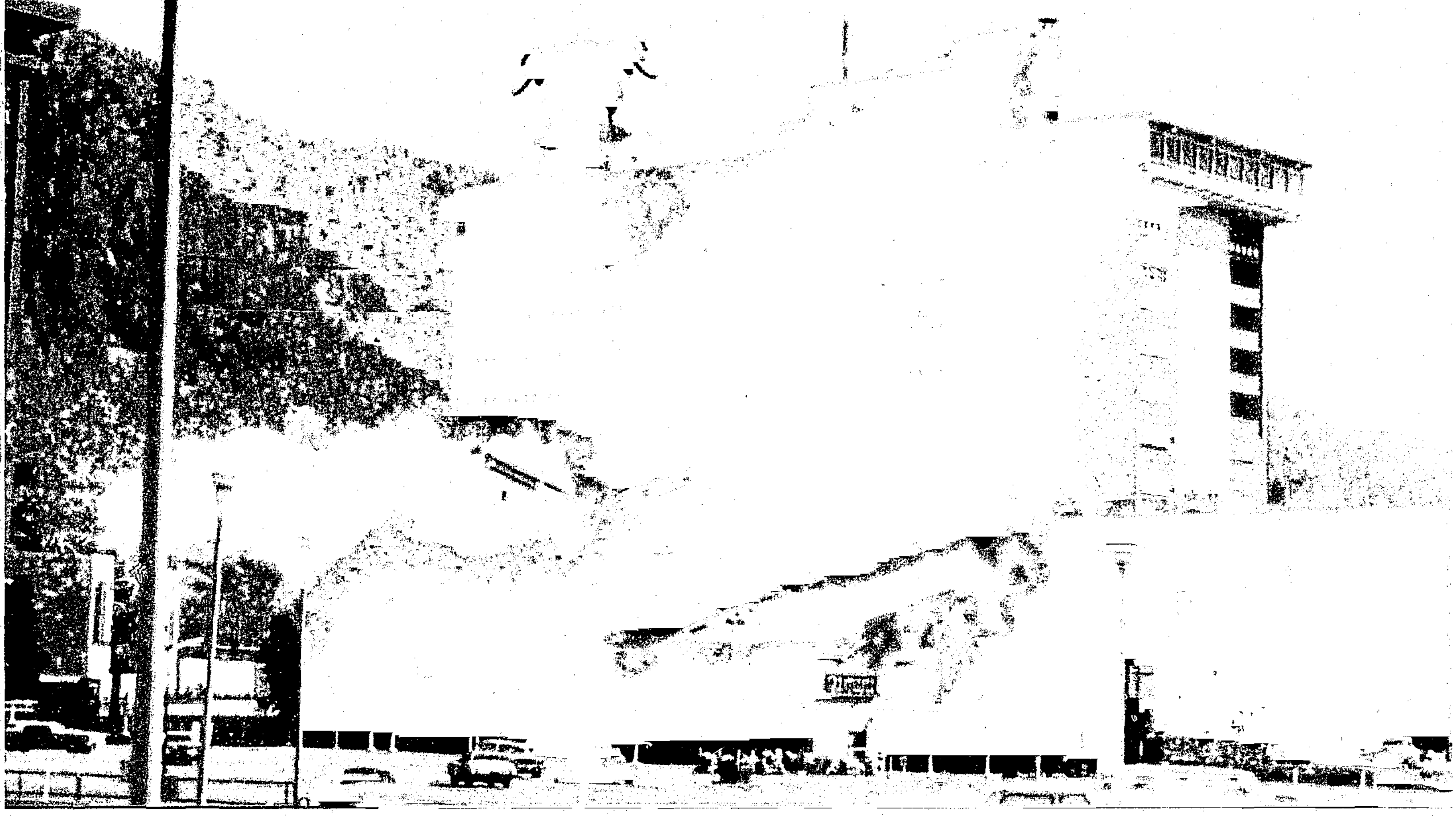

The U.S. Government spends a great deal of time and money to protect the country from both international and domestic terrorism. Private industry, airlines, the military, and law enforcement often express a need for a means to locate various explosives used by terrorists prior to detonation. Due to recent improvements in their sensitivity, selectivity, and capability, explosives vapor detectors now serve as a valuable resource for these types of crime-fighting endeavors.

DESCRIPTION OF DEVICE

An explosives vapor detector is usually a portable instrument composed of two parts—a collecting device, known as a sampler, and an analyzer. Although no two detectors work in the same manner, they operate on the same principle.

The collector sucks in the contaminated air and absorbs it onto some type of surface, such as a platinum wire, which is specifically designed for that detector. Flash heating removes the vapors from the wire and transports them as a stream of gas to the analyzer. The analyzer determines whether explosives are present in the sample. An alarm or light display broadcasts the results.

EARLY DEVICES

Explosives vapor detectors became commercially available in the early 1970s. These first detectors worked on a technology known as electron capture, which is based on the principle that all explosives have a certain chemical nature (electronegative). When explosives vapors are introduced into the electron capture detector (ECD), the detector's standing current changes, and an electronic signal goes off, indicating the presence of an explosive or another electronegative compound.

For example, an explosive such as nitroglycerin (found in dynamite and smokeless powder) has a high vapor pressure, which causes a significant amount of vapor to emanate from it at room temperature. Like a strong perfume, nitroglycerin vapors quickly permeate the surrounding air, and the detector picks them up.

However, many explosives have low vapor pressures, causing very little vapor to emanate from them. This makes them difficult to detect. In fact, in many field tests performed where explosives were present, the detectors failed to find them because so little vapor was present.

While these early detectors successfully detected the presence of dynamite vapor (nitroglycerin), which not only has a high vapor pressure but is also very electronegative, they could detect few other explosives. For example, they failed to detect plastic explosives that usually contained RDX or PETN, which are electronegative but have a very low vapor pressure. Nor were these detectors capable of detecting most low explosives, such as black powder, flash powder, and chlorate/sugar mixtures, often used in pipe bombs or other improvised explosive devices.

In addition, the ECDs indicated many false positives. This problem existed because ECDs reacted with other electronegative chemicals besides explosives. The detector cannot differentiate between an explosive and a nonexplosive; it indicates only the presence of an electronegative chemical. However, despite these problems, law enforcement continued to use ECDs, both in the laboratory and at crime scenes.

ADVANCEMENTS

In the mid-1980s, a private company began work on an explosives detector based on a technology called "chemiluminescence." This technology involves a specific chemical reaction that occurs with most nitrogen-based explosives, but very few other compounds.

The first detector using this technique showed great promise with a wide range of explosives, including plastic explosives, because it improved sensitivity capabilities for detecting those with low vapor pressures. The FBI Laboratory purchased one of the first units manufactured and used it in the laboratory, in case work, and in the field.

Then, in early 1990, a second generation explosives detector, made by the same company, could identify the wide range of explosives of interest to law enforcement with even greater sensitivity. This new generation detector is referred to as a vapor/particle detector, because it has the capability to detect small particles of explosives.

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> **"Due to recent improvements in their sensitivity, selectivity, and capability, explosives vapor detectors now serve as a valuable resource...."**

LAW ENFORCEMENT USE

Explosives detectors can serve law enforcement in several areas, including security, in laboratories, and at crime scenes. Officials use explosives detectors to disclose the presence of hidden explosives on persons, in vehicles, and in buildings.

Security

Law enforcement personnel often find themselves serving in a protective capacity. During these times, they often use dogs to search for explosives in VIP matters. Most police departments, however, do not have explosive-sniffing dogs or ready access to them. And, even departments with dogs cannot use them to search individuals or an area out of the animals' reach. Explosives detectors could help fill this void. In fact, the best bomb search scenario might include the combined use of dogs, detectors, and a visual hand search.

The Department of State uses explosives detectors for security purposes at selected U.S. embassies throughout the world. The FBI has used explosives detectors for security purposes at major sporting events, such as the Pan American Games in 1987 and the Super Bowl in 1991, where officials used detectors to screen vehicles entering the facility. In addition, the Royal Canadian Mounted Police use explosives detectors in a variety of ways—for security purposes, in the field, and at airports to check suspicious luggage.

Shown are two means of vapor/particle detection used at an airport.

FBI Laboratory

The FBI Laboratory has used explosives detectors for over 15 years. The earliest detector used was an ECD to detect the presence of dynamite and other nitroglycerin-based explosives on laboratory evidence.

However, in the late 1980s, the Laboratory began to use the first chemiluminescence-based detector on a limited basis to screen post blast residues from actual bombings. This type of detector successfully locates PETN, a high-level explosive commonly found in plastic explosives. Experts also used it to search the trunk of a vehicle and several pieces of luggage sent to the Laboratory to determine if traces of dynamite were present.

The explosives detector can serve as a valuable tool for the laboratory forensic examiner as well. It reduces the number of actual examinations necessary to complete a search for traces of explosives on various types of evidence. As the reliability of the explosives detector improves, it becomes more valuable in the laboratory.

Crime Scenes

A third law enforcement use of the explosives detector is at crime scenes. The FBI has used detectors at crime scenes to search for explosives and to locate explosives storage areas. If, for example, suspects stored dynamite, TNT, or plastic explosives in a particular location for an extended period of time and then moved them, the explosives detector could most likely reveal the storage site.

The FBI recently used an explosives detector in this capacity in an undercover field operation in a large metropolitan city. One of the goals of this operation was to search several buildings for the presence of dynamite. Posing as utility workers, undercover agents took both air and cloth swab samples at the suspicious locations. The agents wiped automobiles, furniture, doors, etc., with pieces of cloth or swabs, which could pick up any trace of explosives on these surfaces. A vapor/particle detector analyzed the samples. Traces of dynamite were found on at least one of the samples taken during the operation.

Law enforcement personnel can use explosives detectors in the field and laboratory after a bombing to determine which debris contains traces of explosives. At a major crime scene, such as an airplane bombing, thousands of pieces of debris can cover the crash site. The explosives detector can screen the individual pieces for residue to determine which pieces must go back to the laboratory for immediate analysis or which can wait. Use at crime scenes, such as a crash site, could be one of the most valuable applications of the detector by law enforcement.

CONCLUSION

With significant improvements being made in the capabilities, sensitivity, and selectiveness of explosives detectors, law enforcement now has another tool in its arsenal to fight crime. In addition to the techniques previously mentioned, researchers are developing several new technologies for explosives detection, such as ion mobility spectrometry and gas chromatography/mass spectrometry.

The future holds great promise, with scientists working to produce a more sophisticated instrument. Use of the explosives detector to fight terrorism and other crimes helps law enforcement keep communities safe.✦