

CASE REPORT

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An Unusual Explosive, Triacetoneperoxide (TATP)*

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ABSTRACT: An unusual primary explosive, triacetoneperoxide (TATP), was found along with instructions for its manufacture from commonly available ingredients. Melting point data, an infrared spectrum, and both chemical ionization and electron impact mass spectra are included.

KEYWORDS: criminalistics, explosives, triacetoneperoxide (TATP), detonator

Case History

On 1 April 1983, deputies of the San Bernardino County (California) Sheriff's Victorville Station and paramedics of the Hesperia Fire Department were called to a desert location near the community of Hesperia to a report of an injured man. There they found a 26-year-old white male bleeding from numerous puncture wounds of the face, forearms, and legs. The injured man's companion told deputies his friend had placed "electronic detonators" in a glass jar of explosive, which he described as "ammonium nitrate and nitromethane," and, before connecting the detonators to the homemade switch, walked beneath a series of high voltage electric transmission lines, exploding the charge.

A follow-up investigation by detectives of the Bomb/Arson Detail lead them to the suspect's apartment, about 160 km (100 miles) away, in the Orange County (CA) community of Fullerton. There the suspect's roommate showed them numerous chemicals and homemade

*3,3,6,6,9,9-Hexamethyl-1,2,4,5,7,8-hexoxonane.

A preliminary report on TATP was presented at the Sixty-Fourth Semi-Annual Seminar of the California Association of Criminalists [1] and notes reprinted in the *Midwestern Association of Forensic Scientists' Newsletter* [2]. Received for publication 2 Aug. 1985; revised manuscript received 4 Oct. 1985; accepted for publication 7 Oct. 1985.

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explosives, including an improvised blasting cap consisting of a short length of copper tubing filled with a slightly greenish crystalline material. This material was submitted to the San Bernardino County Sheriff's Regional Forensic Science Laboratory for examination.

Results

The initial examination (by C. A. R.) showed the substance to be soluble in common organic solvents (such as chloroform and acetone) and insoluble in water, to give an unremarkable ultraviolet spectrum (Beckman Model 25), and an infrared spectrum (Beckman Micro-lab 600MX) which did not correspond to that of any of the explosives in the laboratory's reference collection.

Additional examination was requested for trial by the prosecuting attorney, and as a result of the original analyst's commitments in another section of the laboratory, the case was reassigned (to H. K. E.). Initial examination of the material by low-power microscopy showed the material to be crystalline, primarily white, but with some blue-green particles and blue-green crystals. The material was examined by thermal microscopy (McCrone Thermal Analysis Computer: MACTAC). Although it appeared relatively pure based upon the clean infrared spectra before and after a chloroform extraction, the melting point was not particularly sharp at approximately 94.7°C. This confirmed the tentative elimination of the common inorganic explosives (based on insolubility in water) [3], clearly eliminated the common nitramine/organic nitrate group (1,3,5-trinitro-1,3,5-triazacyclohexane [RDX], 1,2,4,6-*N*-tetranitro-*N*-methylaniline [HMX], and pentaerythritol tetranitrate [PETN]), and eliminated the nitroaromatic group (2,4,6-trinitrotoluene [TNT], trinitralienzene [TNB], picric acid [PA], and 1,2,4,6-*N*-tetranitro-*N*-methylaniline [tetryl]) [4], with the possible exception of TNT (melting point) [mp] 80.6°C). An attempt to fuse, then supercool, the material to examine it for the "school of fish" crystal habit characteristic of TNT [5] volatilized the crystals.

It was assumed, based upon the case history, that the material was an explosive, but having eliminated the usual candidates, it was necessary to test this premise. Lacking a more formal or elegant method, a small amount of the material was placed upon the concrete slab behind the laboratory and a common hammer, gripped only enough to direct its path, was allowed to fall approximately 0.6 m (2 ft) onto the material. The result of this crude empirical test was that the hammer was rapidly propelled upward with a loud report, leaving no doubt of the material's properties as a sensitive explosive (and no desire to repeat this sort of testing regimen).

Having eliminated the common organic and inorganic explosives, the field apparently was confined to the organometallics, lead styphnate, lead azide, and mercuric fulminate. The infrared spectra did not correspond to any of these compounds, and microchemical analyses for the anions were positive only for the copper [6] suspected accountable for the material's blue-green color. The forensically significant question regarding the material's explosive property having been answered, the identity of the material became one of academic interest, and a sample was dispatched to a colleague (F. A. J. T.) at the neighboring California Department of Justice Laboratory.

Energy dispersive X-ray (EDX) analysis revealed no inorganic ions save the copper, but an additional infrared spectrum (Fig. 1), run as a KBr pellet and later found to be consistent with that previously run, was compared with a published reference spectrum (Fig. 2) [7], and a marked similarity to that of triacetoneperoxide (TATP) (Fig. 3) was noted.

In the meantime, the material was subdivided and a portion dispatched to the Los Angeles Police Department laboratory (B. L. S.) for mass spectrometry. Both chemical ionization (Fig. 4) and electron impact (Fig. 5) mass spectra were run (Finnigan 4000 System) using a solid probe technique, the sample volatilizing essentially as the probe was inserted. Both spectra showed good agreement with those published (Figs. 6 and 7) [7].

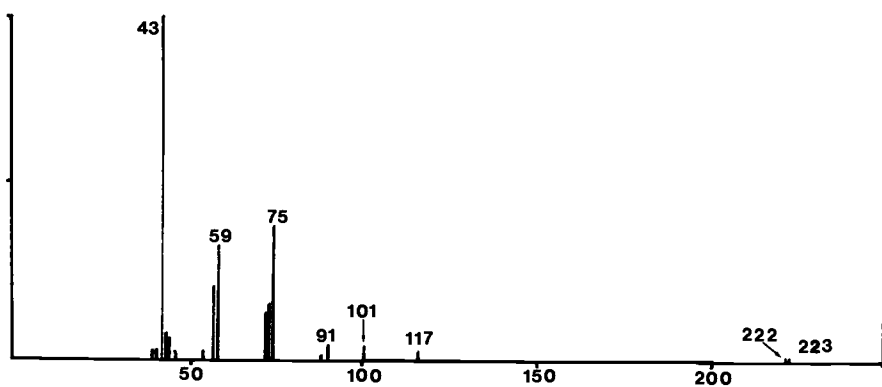


FIG. 5—Electron impact mass spectrum of case sample. Scan m/e 35 to 250.

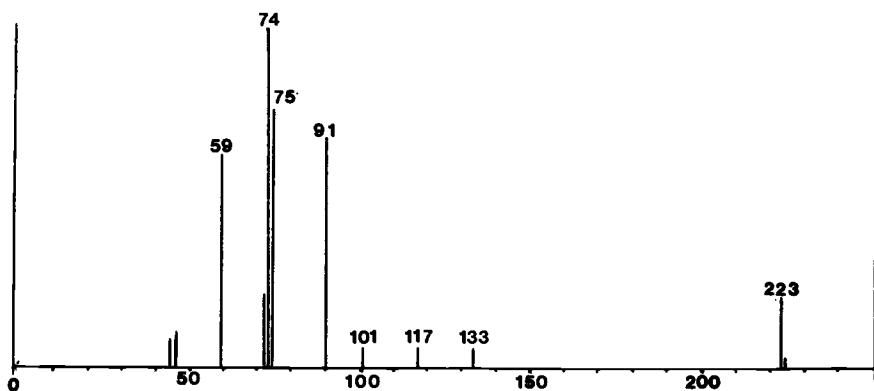


FIG. 6—Chemical ionization mass spectrum of TATP; adapted from [7]. Scan m/e 0 to 200; reagent gas, isobutane.

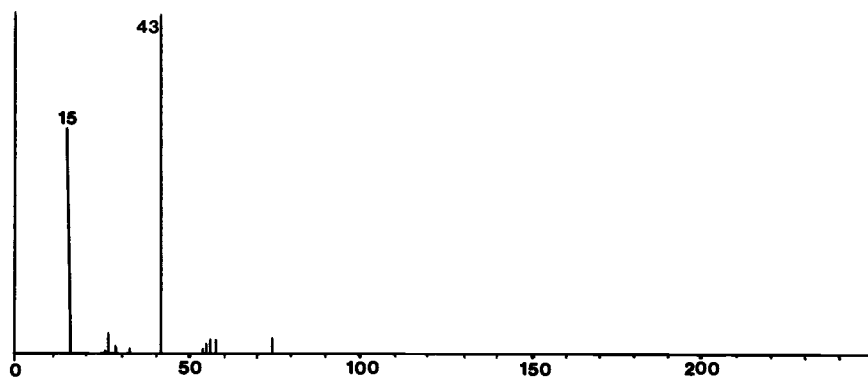


FIG. 7—Electron impact mass spectrum of TATP; adapted from [7]. Scan m/e 40 to 240.

The infrared and mass spectral data, with published spectra as references, identified the submitted material as triacetoneperoxide (TATP). The originally determined volatility and melting point were wholly in agreement with the published literature for TATP [7-11].

Discussion

Triacetoneperoxide (TATP) is not a new explosive, having been first prepared in 1895 through a time-consuming method using acetone, 50% hydrogen peroxide, and small amounts of phosphoric acid [12]. Later methods [9,10], using less concentrated peroxide, also shortened synthesis times considerably.

Besides the obvious academic interest of forensic scientists in any explosive compound, our need to be aware of this compound's existence is more acute since the production or use of TATP or both has now moved out of the dusty realm of 19th century German language chemistry journals into the modern world of terrorists [7]⁴ and the literature of survivalists [13,14].

The formulas in survivalist literature for the production of TATP call for nothing more sophisticated than acetone, 6% hydrogen peroxide, and concentrated sulfuric acid with ether as a solvent.

All of these chemicals are, of course, easily obtained; the acetone as a home workshop solvent, the peroxide at drugstores, the sulfuric acid as a drain cleaner, and the ether at any chemical supply house. The synthesis is no more involved than combining the primary ingredients, cooling to about 5°C, adding dropwise the acid, followed by extraction with ether of the white precipitate so formed. The explosive thus produced, while having the disadvantage of considerable volatility, is among the most impact sensitive, and is highly applicable as a primer or detonator [15].

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