Tagged Out

New markers for explosives may lay old safety questions to rest

By CORINNA WU

Both deliberate and indiscriminate in its destruction, a bomb is the terrorist's favorite weapon. Within the past 3 years, several high-profile bombings on U.S. soil have made that fact all too apparent: the World Trade Center in New York, the Alfred P. Murrah building in Oklahoma City, and Centennial Olympic Park in Atlanta. Evidence now coming to light may add TWA flight 800's fiery crash to the list.

The violence of these events has cast a spotlight on an issue that has been debated for nearly 20 years. Marking explosives with tiny, color-coded plastic chips, or taggants, would enable investigators to trace explosives back to the point of sale. Information about that sale might provide a valuable clue to finding the perpetrators. Widespread tagging might also deter criminals from making and using bombs.

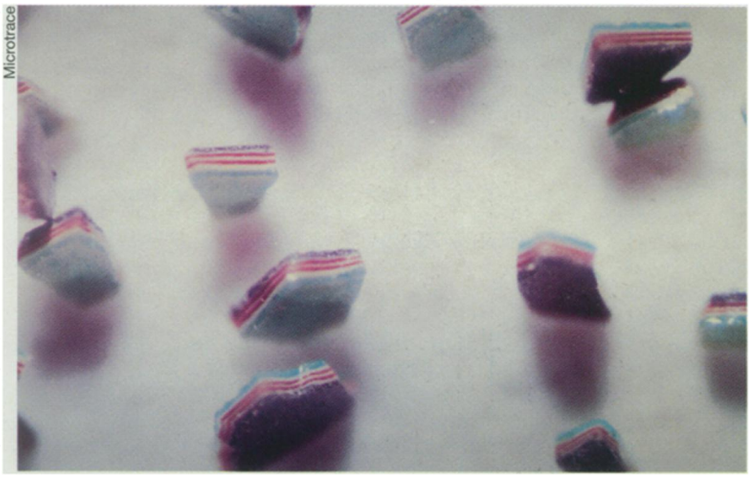
The Antiterrorism and Effective Death Penalty Act of 1996 signed by President Clinton last April authorizes $25 million for a 6-month study of taggants by the Treasury Department, which oversees the Bureau of Alcohol, Tobacco, and Firearms (ATF).

Consideration of taggants has been confounded by disagreement over gunpowder. Easy to obtain, it is a common ingredient of pipe bombs.

Gun users, however, are concerned that tagged gunpowder would be unstable and therefore unsafe for use in bullets. Pressure from lobbying groups such as the National Rifle Association (NRA) excluded gunpowder from the study that was included in the antiterrorism bill, although they say they wouldn't object to a study by an "independent agency." Another bill, passed by the House in July and ready for Senate consideration this month, provides for such a study. The last major government report on taggants, more than a decade ago, concluded that leaving out gunpowder would take the teeth out of any tagging program.

Despite the controversies, a few companies have quietly proceeded with research into tagging. One new approach may make the old worries obsolete.

In the 1970s, Richard G. Livesay, a research chemist at 3M in St. Paul, Minn., invented the most widely used tagging technology. Dubbed Microtaggant, the marker consists of irregularly shaped particles, about a tenth of a millimeter in diameter. To the eye, a pinch of taggants looks like black pepper, but it's really made of up to 10 slabs of brightly colored melamine plastic, a material that's chemically inert and difficult to destroy.



These plastic Microtaggants, each about 0.6 millimeter in diameter, stand at attention through the force of a magnet placed beneath them. The seven colored layers form a unique identification code that can be read easily with a hand-held microscope.

The layers of color in the particles serve as a kind of bar code, identifying the manufacturer, the date of production, and the distributor of a batch of explosives, information that is stored in a database.

For easy detection and decoding, fluorescent and magnetic materials are added to the taggants. If a bomb contains tagged explosives, technicians can shine ultraviolet light to see whether there is any fluorescence among the debris. After scooping up debris samples, they collect the taggants with a magnet. Placing the taggants on a magnet orients them so that their colors are visible. The investigators can then read the colors with a simple light microscope.

Circumventing the technology would take a high level of sophistication. A particularly skilled criminal with the right equipment might be able to produce counterfeit tags, but tagging would eliminate "99 percent of the oafs out there," according to Gary Fuller, now director of research at Basic Technologies International Corp. in Annandale, Va., and a participant in a major study of taggants that began in 1977.

The largest U.S. producer of taggants today is Microtrace, based in Minneapolis. Livesay acquired the license for Microtaggant from 3M in 1985 and formed his own company to manufacture it. "We only make taggants [for use in explosives] for one customer: the Swiss government," says Charles W. Faulkner, general counsel for Microtrace.

The Swiss have used them to solve 559 bombing cases since 1984, he adds.

From 1977 to 1980, Aerospace Corp., now in El Segundo, Calif., conducted a study on Microtaggants for ATF. Working with three leading explosives manufacturers at the time, Atlas Powder Co., DuPont Co., and Hercules, Aerospace tagged about 7 million pounds of explosives, not including gunpowder, over a 1 1/2-year period. Fuller says, "We distributed them all around without a single problem."

For packaged explosives like sticks of dynamite, "the safety issues were put to bed back then," Fuller says. In 1979, a bombing case in Baltimore was actually solved using the taggants. But then the explosive manufacturers began to back out, he adds, mostly for fear of being held legally liable for the damage done by their products.

"Once they realized that [potential liability], the whole program died an ungraceful death."

A 1979 lawsuit filed by Goex, a gunpowder manufacturer, also undermined interest in taggants. Goex claimed that taggants produced by 3M were to blame for a blast at its plant in Camden Park, Ark. Ultimately, 3M was exonerated.

Fuller calls the lawsuit "a pure red herring," but he adds that "there are still some reasons to conduct more tests on smokeless powder and black powder [types of gunpowder]."

The NRA says early tests showed that the gunpowder interacts with some component of the taggants, promoting spontaneous combustion and accelerating degradation.

Those tests were conducted at a high temperature and used very high taggant concentrations, says Faulkner. Though Microtrace's recommended concentration is only 250 parts per million, equal parts of taggants and powder were mixed together in the tests. Under such extreme conditions, he says, "of course it's unstable."

An oft-cited 1980 report on taggants conducted by the Office of Technology Assessment (OTA), the now-defunct research arm of Congress, stated, "Until this presumed incompatibility is resolved, taggants cannot be safely added to these explosive materials." OTA did not independently verify the claims of instability but relied on interviews and the findings of previous studies.

Not much progress on resolving the gunpowder question has been made since. Passage of the pending bill would move the issue forward, Fuller and others predict. Faulkner notes that the Swiss haven't had any problems in their many years of experience with tagged gunpowder and other explosives.

Most attention has focused on packaged explosives and gunpowder, but the experience of Oklahoma City highlighted another kind of threat: the bomb made from ammonium nitrate fertilizer and fuel oil. The 1980 OTA report acknowledged the danger, saying an effective bomb could be made out of those materials "if the criminal has adequate time, skill, knowledge, and motivation."

A company in Houston claims to have a practical way to tag ammonium nitrate and perhaps other ingredients of explosives. By labeling explosives at the molecular level, Isotag says it can produce tags that are cheap, reliable, and chemically inert. "We believe that our technique makes the NRA's concerns regarding destabilization of black powder a moot point," says Isotag's chief financial officer, Desmonde Cowdery.

Rather than using a foreign marker, Isotag modifies the molecules already present in the explosive. By replacing some of the atoms with nonstandard isotopes, which have more or fewer neutrons, the company creates molecules that are chemically identical to the standard version but have slightly different weights.

The isotopically labeled compounds are extremely uncommon in nature, so they can be detected readily. Adding several isotopic markers to an ingredient of explosives—ammonium nitrate is the only one they've tested so far—further increases the rarity of the isotopic bar code.

Unlike the plastic taggants, these markers can only be detected with fairly sophisticated laboratory equipment. If chemically tagged fertilizer were used in a bomb, technicians would need to collect residue at the site and send it to Isotag for analysis. To decode the marker, scientists would separate the constituent compounds with a gas chromatograph and then break each compound apart with a mass spectrometer to reveal the particular combinations of isotopes.

Even though gas chromatographs and mass spectrometers are common fixtures in chemistry labs, a person trying to find the tags would have a hard time identifying the isotopically labeled compounds without knowing the code, says Isotag chemist Ken Laintz. "We take pride in our ability to hide the tags."

The labeled molecules would be used at concentrations of a few parts per billion, and they can be detected when present at concentrations of only parts per trillion.

Isotag completed a study in late 1995 with a major manufacturer of ammonium nitrate fertilizer. It showed that the markers are stable and can survive a blast. But fertilizer companies began to bow out of such marker investigations, as the explosives companies did earlier, preferring to spend their money on combating taggant legislation, says Laintz.

Now, they will have to pick up where they left off. Fertilizers, considered explosive precursor chemicals, are part of the Treasury Department study authorized by the April antiterrorism act. Isotopic marking will probably be included in the tagging study. "We've made information about our technology available to Congress," Cowdery says.

Whether these studies will actually lead to an explosives tagging program remains to be seen. The antiterrorism bill allows the Treasury Department to mandate the addition of markers to explosive materials if they're deemed safe and effective. The pending gunpowder bill, on the other hand, makes no such provision.

Tagging has turned out to be an explosive issue in more ways than one. □

Taggants: Coming soon to a store near you

Identification tags are one ingredient you won't find listed on the back of your shampoo bottle, but that doesn't mean they aren't there. Although explosives are the best-known and most controversial candidates for tagging, they represent only a small share of the market. The Minneapolis-based Microtrace and the Houston-based Isotag mark many commercial products to authenticate brands and deter counterfeiting.

Microtaggants can already be found in at least 500 products, including shampoo, household and industrial paints, and classified military technology, Microtrace's Charles W. Faulkner estimates. One particularly effective application is in marking the glue used to lay down carpeting in buildings. Although contractors often request name-brand glue, Faulkner says, "sometimes, subcontractors use an off-brand glue to save money. Then people complain when the carpet looks like waves on the ocean."

Tagging makes it easy to verify the brand. An inspector can lift up a corner of the carpet, shine an ultraviolet light on the back to find the taggant, and read the color code under a hand-held microscope.

Microtrace is also developing a way to authenticate the bar code stickers on products. Some thieves print their own to buy products at a lower price, then turn around and resell them for a profit.

Which perfumes are tagged?

Products that rely on brand recognition, like gasoline or perfume, face a big problem with counterfeiting. Isotag pushes its chemical marking technology for these kinds of products where plastic taggants would not be practical.

Shady entrepreneurs may buy large volumes of perfume, dilute it, and resell the weak solution as the genuine article. Using a chemical taggant, a manufacturer can check its product at various points in the distribution network to see if and when it's getting diluted. "We're tagging the liquid inside the bottle in lieu of [tagging] the bottle," says Isotag's Ken Laintz. That way, manufacturers can ensure that consumers get what they pay for.