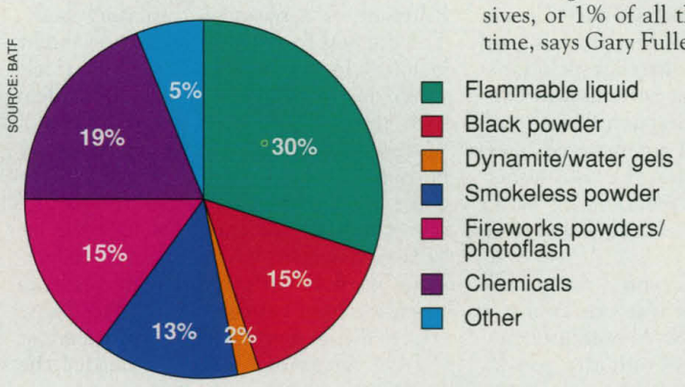
NRC Panel Enters the Fight Over Tagging Explosives

The idea sounds simple enough: Add chemical "tags" to explosives to help detectives sniff out bombs and track down bomb-setting criminals. Calls for implementing such plans have cropped up for decades, usually after well-publicized bombings when the public is anxious for some kind of action. The pressure was on again last year in the wake of the Oklahoma City and Atlanta blasts, and this time it prompted Congress to ask the National Research Council (NRC) to study the matter. But a workshop held last week by the new NRC panel showed just how difficult it is going to be to settle on a workable plan.



Diversity problem. The many different materials used in illicit explosive devices (1990 to 1994) complicate tagging efforts.

Proponents of tagging schemes, largely from companies hoping to sell "taggants," contend that proven systems now exist that can safely tag everything from high explosives to fertilizers to gasoline, all for as little as $5 per ton of bomb-making material. By reading the tags, investigators could track explosives to their point of purchase or theft, narrowing their suspect lists. And while earlier tagging schemes required salting the explosive with foreign objects, perhaps affecting its stability, chemists now have come up with subtler methods relying on everything from snippets of coded DNA or heavy-isotope twins of molecules already found in explosives.

Still stymied. Pipe bombs like the one set off at last summer's Olympic Games are easily made from off-the-shelf materials.

Manufacturers and other industry groups argue, however, that even these new tagging schemes are costly and would swamp manufacturers with paperwork for tracking the movement of millions of tons of chemicals. Even law enforcement officials question whether it's the best way to spend scarce funds. Says J. Christopher Ronay, former head of the FBI's bomb squad, who now serves as the president of the Institute of Makers of Explosives (IME) in Washington, D.C., designing a nationwide tagging program "is no slam dunk."

Taggants were first produced in the United States in the early 1970s by 3M chemist Richard G. Livesay, who was angered by a Vietnam-era bombing at the University of Wisconsin, Madison, that killed one person and injured three others. Livesay's work led to tags that were pepper-grain–sized plastic chips made from eight or nine layers of colored plastic that could be stacked in millions of different combinations to code for an explosive's manufacturer, the production lot, and the distributor to whom the product was sent. The chips contained additional fluorescent and metal layers to help investigators pick out the chips easily with ultraviolet light and magnets in the debris of a bomb blast.

But industry-sponsored tests of the chips found problems. One test, cited in a 1980 report by Congress's now defunct Office of Technology Assessment, found that when large amounts of the chips were added to the types of powders used in bullets and other ammunition, they became chemically reactive. That raised fears that the chips could cause the powders to explode prematurely.

Some tagging experts, pointing to a pilot study of the chips sponsored by the federal Bureau of Alcohol, Tobacco, and Firearms in the late 1970s, say the risks have been overstated. Between 1977 and 1979, colored chips were added to a total of 2.9 million kilograms of 79 different types of explosives, or 1% of all those made during that time, says Gary Fuller, who helped conduct the pilot study for the Aerospace Corp. and who now works for Systems Support Inc., a scientific consulting firm in Great Falls, Virginia. "No safety problems were ever observed," he says. Explosives tagged for the study even helped federal investigators track down and convict a bomber in Baltimore who had killed a family member. He also points out that taggant chips have been used without incident for 12 years in Switzerland, which in 1980 required that all explosives produced in that country be tagged.

In any event, rainbow-colored chips are no longer the only tags on the block. In fact, representatives from fully 10 companies presented a host of tagging schemes to the NRC panel, including taggants made from combinations of rare earth elements and multicolored phosphors. Taggant company officials point out that several of these tags have already proven their worth by helping track industrial counterfeiting in products ranging from shampoo and perfume to olive oil and gasoline. By placing tags in these products, manufacturers can finger distributors who are boosting their profits by mixing their products with cheap, off-brand varieties.

A scheme that may go the furthest to address safety concerns creates tags with heavy-isotope twins of molecules already found in explosives. The technique, proposed by a pair of companies—Isotag, Limited Liability Corp., based in Houston, and Cambridge Isotope Laboratories, based in Andover, Massachusetts—relies on stable, nonradioactive isotopes of hydrogen, carbon, nitrogen, and oxygen, which differ only in atomic weight from their more common counterparts. By replacing normal isotopes with their off-weight twins at several points on one or more molecules, chemists can write millions of different codes. Because each code results in a slightly different molecular weight, these tags are easy to detect with a conventional mass spectrometer. "It can be 100% safe, because we tag with the same stuff that's in there already," says Isotag

co-founder Manny Gonzalez.

Last year, Isotag researchers conducted initial tests in the Nevada desert, setting off a pair of blasts each containing 1 ton of ammonium nitrate and fuel oil—the same explosive responsible for the Oklahoma City blast—spiked with their isotope tags. The test, Gonzalez says, showed that the heavy isotopes survived the blast and were easily detectable.

IME's Ronay says the new tags seem to be an improvement over the plastic chips. "Apparently, they are less intrusive on the product. If the cost is acceptable, we would have no objection to [their widespread use]."

But at this point, Ronay and others say that tagging is still too expensive. At the meeting, taggant company officials estimated that isotopic labeling of a ton of material would cost about $5 to $15, though a variety of strategies are being considered to lower the cost further. For the explosives industry, which produces some 2.5 million tons of dynamite and other high explosives every year at a cost ranging from $1000 to $2000 a ton, that would come to a tab of $12.5 million to $37.5 million a year. Tagging the 8.3 million tons of ammonium-nitrate fertilizer—the type that can be used to make bombs, which is produced annually at a cost of about $400 a ton—would add another $41.5 million to $124.5 million.

Moreover, manufacturers argue that they would have to revamp their production procedures to mix in taggants properly. One particular concern, says Ronay, is that taggants from one batch could get lodged in the equipment, later breaking free and contaminating a subsequent batch with the wrong code. Manufacturers worry that, to prevent this, they will be required to stop production after each batch is run and clean their equipment, which would drive up production costs.

Another concern, says Marybeth Kelliher of the Chemical Manufacturers Association in Arlington, Virginia, is that a tagging program would require manufacturers to set up an extensive tracking system to follow the distribution of each batch of tagged chemicals. That could be particularly onerous for companies producing black and smokeless powders used in ammunition, because single lots of powder typically get distributed to stores all around the country. The burden wouldn't end there: To make the taggants useful, store owners would have to record the name and address of everyone who buys a box of powder-containing bullets, says Sergeant Howard Rechtshaffen, a bomb detective with the Los Angeles County Sheriff's Department in Whittier. And due to the regulatory and privacy hassles that would create, he says, "I'm not even sure I'd want that."

Underlying industry's concerns, however, may be deeper concerns about legal liability for damage from blasts. Taggants could lead not only investigators, but lawyers for the victims, directly to explosives manufacturers. "If an explosives manufacturer can be identified, it gives the public someone to blame," says Linda Nelson, a marketer for Biocode, a taggant company based in Cambridge, Massachusetts.

Still, even advocates, including police detectives present at the workshop, don't view chemical taggants as a panacea. "Will [taggants] help convict criminals? I'm sure of it," says Rechtshaffen. "But we need to prevent [bombings] more than anything else." "It's a matter of priorities," adds panel member Robert Pentz, director of the western region of the Department of Justice's National Law Enforcement & Corrections Technology Center. "Is this money spent better somewhere else?" That may well be the toughest question the NRC panel will have to answer.

–Robert F. Service

GERMANY

Leaders Protest Cuts in Science Support

BERLIN—In a highly unusual appeal, leaders of five of Germany's premier scientific organizations last week issued a dire public statement about the future of German research. They warned that their nation—which has produced some of the century's greatest scientists—is in danger of squandering golden scientific opportunities unless government and industry "significantly increase" their investments in research and work to make higher education more competitive. The German government and industry are now "walking arm in arm in the wrong direction," the statement declares.

The document was signed by five of the most influential people in German science: Max Planck Society (MPG) president Hubert Markl; Wolfgang Frühwald, head of Germany's main research-granting agency, the DFG; Reimar Lüst of the Alexander von Humboldt Foundation in Bonn; Dieter Simon of the Berlin-Brandenburg Academy of Sciences; and Wolf Lepenies, rector of the Berlin Institute for Advanced Study. Entitled "Priorities for the Future," their proclamation noted that Germany's R&D spending has fallen to 2.2% of gross domestic product—continuing a downward trend since reunification with the east in 1990. The statement says Germany must increase that spending level to nearly 3% to "secure a leading place" among industrialized nations, some of which now spend more than 2.6% of their national income on R&D.

Markl—a prominent biologist who became president of the MPG last year—says the statement challenges all of the major players in German research, including industry, federal and state governments, scientific institutes, and universities. "Industry is of paramount importance," he says, noting that nearly 60% of all R&D funds come from German industry. "The cuts by industry and the [state governments] have been much more drastic" than the federal government's budget reductions, he says. According to some estimates, German industry has cut nearly 40,000 R&D positions in recent years. Also, severe cutbacks in university budgets in states such as Berlin are hurting university research.

The German government and industry are "walking arm in arm in the wrong direction."
—Scientists' statement

The federal government must also bear part of the blame for the plight of research. In an austere 1997 budget that aims to meet spending criteria for European monetary unification, the Federal Ministry of Education, Science, Research, and Technology was dealt a budget cut of 3.7%. The blow was, however, softened by increases of about 5% for both the MPG and the DFG (*Science*, 6 December 1996, p. 1606).

The scientific leaders urged Germany's states to join with the federal government to make the nation's universities more flexible and open to innovation—a goal now being advanced by education and research minister Jürgen Rüttgers. The statement also recommends that, rather than spreading resources evenly among mediocre institutions, Germany should focus more research money on the most dynamic and productive research centers.

"This document is an expression of deep concern," Markl says. "It is a challenge to all those who must make the important decisions on research and education in the coming years."

–Robert Koenig

Robert Koenig is a writer in Berlin.