RUNAWAY REACTIONS

Bayer accident DETAILS REACH PUBLIC as safety board, Congress release preliminary investigation results

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AT ABOUT 10:30 PM last Aug. 28, Sean Smoot was sitting in his living room with his wife and two sons. For 12 years, the Smoot family has lived in St. Albans, W.Va., across the Kanawha River from the Bayer CropScience plant and 10 miles west of Charleston.

"I heard a big explosion," Smoot tells C&EN. "It was so loud, it was scary. At first, I didn't know where it came from. Then I thought, 'Oh my God!' And I knew what happened had to be over there," he says, pointing to the plant across the river from his backyard.

"We all got up and went to the back window, and we saw the plant on fire. Then we saw smoke going up into the air," Smoot recalls.

The wind was blowing the "wrong" way, Smoot says, meaning that the wind was not coming from the usual direction. "It was blowing toward us and I could smell a scent. We all got in the car and drove as far away as we could get. We didn't come back until the next day."

Smoot and others in the community around the plant have been in the dark about what happened during the Aug. 28, 2008, explosion, primarily because Bayer has sought to block release of accident details. A public hearing organized by the Chemical Safety & Hazard Investigation Board (CSB) and held on April 23 at a university next to the Bayer plant was the first time residents fully learned that the accident was the culmination of a series of avoidable errors and that they narrowly avoided a more massive disaster.

West Virginia State Fire Marshal Sterling Lewis also lives near the plant, but unlike Smoot, he drove toward the facility on the night of the explosion. He learned of the fire and explosion from the local 911 operator, he recounted at the CSB hearing. The operator called to tell him that the state's emergency hazard response team, which he directs, should be standing by.

"Why?" Lewis said he asked the 911 operator, who was receiving many calls about an accident at Bayer.

"She said she didn't know what the problem was. I advised her that I would respond personally to see if the response team was needed," he said. Then Lewis jumped into his car and headed to the plant.

As he drove through Nitro, W.Va., which is just west of the Bayer facility, Lewis confronted a "tremendous amount of smoke" and an unusual odor, "not like the stuff you usually smell when you drive through Nitro," he recalled.

When he got to the Bayer plant's gate, Lewis showed his badge and ID to the plant guard, but the guard refused to let him—the state's fire marshal—in. Lewis sat at the plant gate for 40 minutes, slowly being joined by other state and local emergency response officials who came to the site to find out what happened. The only responders Bayer let through were local volunteer fire fighters, who were struggling along with Bayer employees to contain the huge fire.

Time ticked by and eventually he and the other emergency responders were ushered in but directed to a room away from the accident scene, Lewis said.

Two workers died from the blast: One was killed that night, and the other died 41 days later in a Pittsburgh burn center. Lewis got into the plant only when Bayer officials wanted the dead victim to be taken away before the shift change, as incoming workers were "uneasy" about the incident, Lewis said. Bayer officials then allowed Lewis and the state medical examiner into the plant and accident scene to examine and remove the body.

"At the end of the night, I knew no more about the accident than I did six hours earlier," Lewis said.

Lewis would know much more by the time the CSB hearing in Institute, W.Va., came to an end. More than 340 local residents packed a hall at West Virginia State University, a historically black university that abuts the east boundary of the Bayer plant. CSB normally holds such hearings to inform the community about its ongoing accident investigations, which is the charge of the federal agency. The Institute meeting was the biggest the board had ever held.

IT BEGAN with a detailed explanation of the board's investigation, followed by a discussion of the accident by a panel of six experts, including Lewis, as well as Bayer's plant manager, and it ended with the community telling the board their views. The hearing ran for four hours; 18 public comments took more than an hour; only one person defended Bayer.

Bayer's storage and use of large quantities of methyl isocyanate (MIC) fueled community concerns. The same chemical

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resulted in the deaths of several thousand people living near a Union Carbide plant in Bhopal, India, in 1984. Since 1984, community members have urged the plant owners—including Union Carbide, which owned the plant in 1984, and three others that followed, including Bayer, which purchased it in 2002—to change their processes and to formulate and use MIC immediately and avoid storing it, or to drop its use altogether. All facility operators have refused, including Bayer.

Bayer is the only U.S. chemical company today that stores large quantities of MIC, according to CSB. Other companies have turned to immediate formulation and use, including DuPont, which used to buy MIC in containing the fire, who were treated for chemical exposure.

At the CSB hearing, the board’s investigators underscored Bayer’s refusal to report accident details to local emergency responders and 911 operators who were swamped with citizen calls. Other than reporting an emergency and requesting an ambulance, plant officials did not tell local emergency response officials what actually happened.

Thirty minutes passed before Bayer recommended to the 911 center that a shelter-in-place be ordered, CSB Chairman John S. Bresland told meeting attendees. By then local emergency officials who could see the fire and smoke but could not gain access to the site had ordered the same.

Bayer remained silent until the week of April 20, when CSB and a congressional committee—the House of Representatives Energy & Commerce Subcommittee on Oversight & Investigations—released separate reports on the accident. As a result, accident details were finally made available to an angry community hungry for information.

The House hearing took place on April 21. It focused on the impact of Bayer’s refusal to discuss accident details with emergency personnel and its intent to limit what CSB could make public. Information released in a committee report included internal Bayer documents showing their concern about community opposition to its use of MIC.

Bayer had reason to be concerned. CSB’s preliminary investigation found that the portion of the plant that caught fire used MIC to manufacture the insecticide Larvin and that the explosion occurred 80 feet from a tank holding more than 13,000 lb of MIC, said Bresland at both meetings. This tank had a capacity to hold 40,000 lb of MIC and is one of two on site that hold the chemical. The other tank typically contains 200,000 lb of MIC, many times more than was leaked at Bhopal.

The board’s investigation is not yet complete, but it has uncovered the likely cause of the accident. Although CSB has investigated some 55 disasters, this one has been extremely complicated by Bayer’s unwillingness to inform the community about the accident’s cause and what chemicals were emitted, as well as details about the incident itself.

As CSB planned the public hearing that eventually took place on April 23, Bayer tried to retroactively claim that material it had already supplied to the board was “sensitive security information” (SSI)—a classification defined in chemical plant security laws. SSI is part of the plant’s anti-terrorism security plan and therefore could not be made public, Bayer said. CSB was allowed to proceed with a public hearing only after a review of the material it intended to disclose by the Coast Guard, which oversees the relevant security law. Because of Bayer’s maneuver, however, CSB halted its investigation and put off the meeting while it negotiated with the company and Coast Guard over what the agency could make public from its investigations. Bayer claimed some 2,000 documents as SSI, but CSB eventually prevailed and faced few restrictions in what it could release at the meeting (C&EN, April 20, page 36).

MIC USE has driven the company to avoid public disclosure, according to William Buckner, Bayer CropScience’s president and chief executive officer. Bayer sought confidentiality to block community access to company information and avoid public pressure to reduce or eliminate MIC use at the plant, he acknowledged at the House hearing on April 21.

From the time of the accident itself, community members have worried about what was released in the plume of chemicals that left the plant. In Bayer’s plant guard’s first response to the community, 15 minutes after the accident occurred; in company testimony at the congressional hearing; and in a statement at the CSB meeting by Bayer Institute Site Operations Vice President Nick Crosby, company officials have asserted that no dangerous chemicals were released.

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“That statement is clearly incorrect,” Bresland said at the hearings. The fire was fueled by solvents and methomyl, a feedstock for Larvin, CSB has found. Bresland noted that methomyl is toxic and its uncontrolled decomposition may release highly toxic by-products, such as MIC, hydrogen cyanide, acetonitrile, and others.

Immediately surrounding the area where the accident happened were 16 air monitors that could have detected MIC, according to CSB’s investigation. None of them, however, were operating during that tragic night. In addition, the facility has three fence-line monitors to cover the 400-plus-acre site, which has a perimeter of more than 3 miles, but only two of those were operating that night. Bayer also has four handheld monitors, but only one of those was deployed on Aug. 28, said Bayer’s spokesman Iams. Iams and Crosby say no dangerous readings were observed.

MIC is used in four processes in the plant, two of which pull MIC from a “day tank” located near the methomyl-Larvin unit, which exploded. Methomyl is synthesized from MIC and other chemicals, and through the process that exploded, methomyl is in turn used as a feedstock for Larvin.

During a production outage of the methomyl-Larvin unit last summer, Bayer had replaced an old 10-foot-tall, 5,500-lb cylindrical “residue treater vessel” used to process liquid-waste methomyl and solvents left over from the production of Larvin, according to John Vorderbruggen, CSB’s lead investigator, speaking at CSB’s public meeting. The company also replaced its computerized process control system.

As the methomyl-Larvin unit start-up began, workers were still learning the control system and had been working long 12-hour shifts, Vorderbruggen continued.

Methomyl is highly reactive, and when heated in solution it decomposes, breaking down chemically while producing heat, which aids the decomposition reaction. Bayer’s residue treater takes advantage of this characteristic in a process called liquid-waste methomyl and solvents.

To control the reaction in the residue treater, however, the vessel is designed to process methomyl in small quantities so that it is less than 1% of the solution when mixed with solvents. After treatment, remaining chemicals are recycled or incinerated.

To begin start-up of the methomyl-Larvin unit, Bayer’s written process requires outside heat to trigger the reaction in the residue treater. Once begun, external heat and cooling controls the heat that is generated primarily by methomyl decomposition in the vessel and thereby the reaction. However, Bayer had known for years that the unit’s auxiliary heaters were insufficient to initiate start-up, according to CSB. Consequently, Bayer had increased the release of methomyl to the treater to help generate heat to kick off the decomposition process.

To increase the tank’s methomyl content, however, Vorderbruggen said, Bayer had to disable three safety interlocks that controlled the methomyl feedstock release. As a result, on that August night, the residue treater contained too little solvents and far too much methomyl in the mix. As the methomyl decomposed, the temperature and pressure rose, Vorderbruggen said. Confused control operators sent two workers to the tank to physically see whether a vent valve had become blocked.

As the two approached the vessel, its relief valves opened and were overwhelmed by the runaway reaction: The treater ruptured and ejected some 2,500 gal of flammable liquid wastes, and the 5,500-lb vessel careened some 50 feet, cutting a swath through a maze of pipes and steel at the plant.

It flew in a direction away from the nearby MIC day tank, however.

THE ACCIDENT, Bresland said, was avoidable and showed significant lapses in the plant’s process safety management and, he added, “could have had additional grave consequences.”

Crosby acknowledged and apologized for communications that fell short. Bayer has developed new arrangements to inform local emergency officials more quickly, he noted. The state has also passed legislation requiring companies to notify response officials of an incident within 15 minutes. However, Bayer had agreed to improve community communications after an accident in the same unit in 2007, according to speakers at the CSB hearing.

Defending Bayer’s use and storage of large quantities of MIC, Crosby said that it was a “critical building block.” Bayer had examined options, and “our process is as safe as alternatives,” he said.

Company spokesman Iams stresses the “business need” for MIC’s use at the Institute plant and Bayer’s decision to make Institute the only production site for its insecticide line.

CSB’s final report will be delayed until the end of the year because of time needed to comply with Bayer’s SSI claims and the Coast Guard reviews, Bresland tells C&EN. However, he says, the final report will include examination of process alternatives to MIC storage and will use computer modeling to determine what chemicals exited the plant during the fire and explosion.

CSB’s decision to examine MIC alternatives received support from a May 4 letter from four House and Senate committee leaders to the board, calling for the board’s examination of the board’s examination of the board’s examination of the board’s examination of the options and costs of shifting away from MIC use or storage.