



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: March 12, 2001

In reply refer to: I-01-05

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The National Transportation Safety Board is an independent Federal agency charged by Congress with investigating transportation accidents, determining their probable cause, and making recommendations to prevent similar accidents from occurring. We are providing the following information to urge your organization to take action on the safety recommendation in this letter. The Safety Board is vitally interested in this recommendation because it is designed to prevent accidents and save lives.

This recommendation addresses the sufficiency of safety requirements concerning the procedures used for loading and offloading railroad tank cars and other bulk containers used to transport hazardous materials. The recommendation is derived from the Safety Board's investigation of the catastrophic rupture of a railroad tank car containing hazardous waste near Clymers, Indiana, on February 18, 1999,¹ and is consistent with the evidence we found and the analysis we performed. As a result of this investigation, the Safety Board has issued 10 safety recommendations, 1 of which is addressed to the Lyondell Chemical Company. Information supporting this recommendation is discussed below. The Safety Board would appreciate a response from you within 90 days addressing the actions you have taken or intend to take to implement our recommendation.

About 12:05 a.m. on February 18, 1999, railroad tank car UTLX 643593, which was on the west unloading rack at the Essroc Cement Corporation cement plant near Clymers, Indiana, sustained a sudden and catastrophic rupture that propelled the tank car's tank about 750 feet and over multistory storage tanks. There were no injuries or fatalities. Total damages, including property damage and costs from lost production, were estimated at nearly \$8.2 million. The National Transportation Safety Board determined that the probable cause of the accident was the failure of Essroc Cement Corporation (Essroc) and CP Recycling of Indiana (CPRIN) management to develop and implement safe procedures for offloading toluene diisocyanate (TDI) matter wastes,

¹ For more information, see forthcoming Hazardous Materials Accident Report NTSB/HZM-01/01: *Catastrophic Rupture of a Railroad Tank Car Containing Hazardous Waste Near Clymers, Indiana, February 18, 1999* (Washington, DC: National Transportation Safety Board, 2001).

resulting in the overpressurization of the tank car from chemical self-reaction and expansion of the TDI matter wastes.

Essroc had been attempting to transfer the substance in the tank car, TDI matter waste, to its kilns, where it was to be burned as a fuel. CPRIN was Essroc's on-site contractor for steam heating tank cars containing waste fuels. TDI matter waste is a flammable, toxic, and hazardous substance that must be disposed of in accordance with Environmental Protection Agency regulations. This tank car containing TDI matter waste had been sent to Essroc by the Arco Chemical Company (later purchased by the Lyondell Chemical Company [Lyondell]), which owned the Lake Charles, Louisiana, facility that had generated (in 1993) the TDI matter waste as a byproduct of TDI production.

The ownership of the Lake Charles facility changed three times between 1993, when the tank car was loaded, and 1999, when Essroc attempted to unload the tank. When UTLX 643593 was loaded in 1993, the Olin Corporation (Olin) owned and operated the Lake Charles plant. In December 1996, Olin sold its TDI production business, including the Lake Charles plant, to the Arco Chemical Company (Arco). In July 1998, Lyondell acquired Arco and its assets.

In 1996, Essroc began to accept TDI solvent blend wastes from Lake Charles as fuel for its cement production plant between Clymers and Logansport, Indiana. Blending agents such as HAN 906 solvent were added to the TDI solvent blend wastes at the Lake Charles plant before they were shipped to Essroc, to increase the fluidity of the wastes. However, beginning in spring 1998, nearly all the TDI wastes shipped to Essroc from Lake Charles were TDI matter wastes. Unlike the solvent blend wastes that had been "thinned" before shipment to Essroc, the TDI matter wastes were to be heated and offloaded from the tank car to a blending tank at the Essroc plant, where the wastes would be mixed with solvents to "thin" them before they were pumped to the kilns and burned. However, problems with the blending tank operation led Essroc to resort to offloading the TDI matter wastes from the tank cars and pumping them directly to the kilns, a procedure known as the "direct injection process." Essroc was using the direct injection process to offload the TDI matter wastes from UTLX 643593.

Whereas the waste profile for the solvent blend waste specified a maximum viscosity of 500 centipoise, the profile for the TDI matter waste indicated that its viscosity "varies." Because the TDI matter wastes in UTLX 643593 (and other tank cars sent to Essroc from Lake Charles) were to be blended at the Essroc plant, they typically were more viscous than the solvent blend wastes. Consequently, the TDI matter wastes probably had to be heated for longer periods and to higher temperatures than the solvent blend wastes, to make the TDI matter wastes sufficiently fluid for offloading from a tank car and pumping directly to the kilns.

The heating standard jointly employed by Essroc and CPRIN personnel was to heat the TDI matter waste until it was sufficiently fluid to flow. While CPRIN conducted the steam-heating operation, Essroc personnel drew samples from UTLX 643593 to measure the temperature of the wastes and to determine if the waste mixture was sufficiently fluid for offloading. Although Essroc and CPRIN personnel said they knew that the TDI matter wastes had to be heated to higher temperatures than the solvent blend wastes, Essroc and CPRIN claim they were unaware that Olin had recommended a maximum safe temperature range of 130 to 140° F for heating the TDI matter wastes. The Essroc facility supervisor said he was under the impression that the TDI matter wastes

could safely be heated to 200° F, whereas CPRIN stated that, although the TDI product should not be heated above 110° F because of possible quality control problems, these concerns did not apply to the TDI matter wastes.

Further, the offloading and steam-heating procedures used by Essroc and CPRIN did not include three critical heating and offloading practices that Olin had used at the Lake Charles plant: steam heating with low-pressure steam, nitrogen sparging while steam heating, and keeping the temperature of the waste mixture below 140° F. Through steam heating with low-pressure steam, the waste mixtures could be heated more slowly and could more easily be maintained at a temperature below the 130 to 140° F threshold recommended by Olin. Performing nitrogen sparging during the steam-heating process would cause the waste mixture at the bottom of the tank car to agitate, which would facilitate a more even distribution of heat throughout the entire waste mixture. The Safety Board concluded that, if Essroc and CPRIN had employed low-pressure steam to heat the wastes, used nitrogen sparging to facilitate even heating throughout the tank car, and maintained the temperature of the wastes below 140° F, the risk of localized overheating and expansion of the waste mixture would have been minimized, and the accident likely would not have occurred.

To determine why Essroc and CPRIN did not employ the procedures used at the Lake Charles plant, the Safety Board asked Olin, Lyondell, Essroc, and CPRIN to describe the information they exchanged about the heating of all TDI waste mixtures, the generation of gas from chemical self-reaction, the expansion of the wastes if overheated, nitrogen sparging, the establishment of temperature limits for the waste mixtures, and other special handling procedures.

Each company provided a different account regarding its responsibilities and the information it either provided or requested. All agreed that a Lake Charles TDI expert met with Essroc and CPRIN personnel at the Essroc plant in spring 1998 to provide instruction on handling and processing TDI matter wastes. The Lake Charles operators, Essroc, and CPRIN agreed that the TDI matter wastes could safely be heated to 125° F, compared to the 90 to 100° F range for the TDI solvent blend wastes. Essroc also acknowledged that the Lake Charles TDI expert had stated that a long, slow heating process was sometimes required to heat the TDI matter wastes. However, neither Essroc nor CPRIN acknowledged that the Lake Charles operators had set a maximum temperature limit or that the Lake Charles operators had recommended using nitrogen sparging and low-pressure steam-heating procedures. The Lake Charles operators, however, maintained that their TDI expert discussed nitrogen sparging, heating with low-pressure steam, and heating limits with Essroc and CPRIN personnel.

As can be seen from this diversity of opinion and recollection as to what was communicated between the producers and receivers in this instance regarding the appropriate procedures for offloading the TDI matter wastes, considerable confusion and misapprehension appears to have been prevalent among those parties that handled the TDI waste mixtures. Given the potentially hazardous nature of TDI matter wastes, such ambiguity is unacceptable.

The investigation also revealed other areas of imprecision. For instance, responsibility for offloading at the Essroc plant seems to have been unclear. Essroc stated that CPRIN was responsible for steam heating the TDI product so that it was sufficiently fluid that it could be pumped to the cement kilns. CPRIN, however, stated that Essroc retained operational authority over the heating and offloading process.

Further, no one at the Essroc plant had comprehensive, written instructions on the offloading procedures to be used. Although Essroc had written procedures for offloading the TDI matter wastes to a fixed blending tank, these procedures did not include details about heating practices, nitrogen sparging, or maximum temperature limits. Then, when Essroc adopted the direct injection procedure in place of blending in a fixed tank, even less information was available. Neither Essroc nor CPRIN had any written procedures for heating and offloading the TDI matter wastes for direct injection of these wastes to the kilns.

Therefore, based on the discrepancies between Essroc's and CPRIN's accounts of their respective roles and responsibilities for handling and disposing of TDI matter wastes and the absence of specific, written procedures for heating and offloading these wastes by direct injection, the Safety Board concluded that Essroc and CPRIN failed to develop and implement appropriate heating and offloading procedures for the TDI matter wastes at the Logansport plant, which resulted in the use of unsafe offloading practices at the plant.

With respect to the Lake Charles operation's procedures, Olin stated, in its response to Safety Board inquiries about whether it had written procedures for heating and offloading TDI wastes, that any written procedures that might have existed had been turned over to Arco (later Lyondell). Lyondell stated that Arco/Lyondell did not have specific, written procedures for on-site blending of the TDI waste mixtures and offloading them from tank cars. Arco/Lyondell had written procedures for blending solvent blend wastes in a fixed tank and then transferring them from the fixed tank into tank cars. These procedures set the temperature and viscosity limits for the solvent blend wastes in the fixed blending tank. However, neither Olin nor Arco/Lyondell had written operating procedures or limitations that addressed the potential for gas generation or product expansion, the maximum temperature and time for heating the TDI wastes, or the maximum product viscosity for offloading tank cars. Therefore, no one at Lake Charles appears to have had comprehensive, written procedures for handling the TDI wastes.

The Safety Board also considers that the implementation of comprehensive, written procedures for loading and offloading chemicals or waste materials exhibiting properties that require special handling must incorporate methods that will detect internal tank conditions and accurately reflect the thermophysical state of all of the material in the tank vessel. The written procedures should specify values or ranges for important material properties such as melting temperature, flash point, maximum allowable product temperature, and viscosity. Further, offloading procedures developed and validated under certain environmental conditions may lead to or cause catastrophic failures or other potential problems in offloading the material when the environmental conditions vary from the baseline conditions.

Partially because there is no written record to which it may refer, the Safety Board cannot decisively determine what information and guidance were provided by the Lake Charles operators to Essroc and CPRIN on heating and offloading TDI matter from tank cars or what consideration, if any, was given to detection of internal tank car conditions that were potentially catastrophic. Nor can the Safety Board be sure what guidance may have been provided by the Lake Charles operators but not implemented by Essroc and CPRIN. Nevertheless, given the differences between the accounts offered by these companies about the guidance given or requested and the lack of comprehensive, written procedures at Lake Charles for handling TDI

wastes, the Safety Board concluded that Olin and Arco (now Lyondell) did not provide Essroc with comprehensive, written information about safe handling procedures for TDI matter wastes.

The Safety Board considers that the producer/shipper and the consignee/end-user of any chemical or waste material have joint responsibility for determining and implementing comprehensive, written procedures for the transfer of any chemical or waste material to and from a tank car, highway cargo tank, or other bulk container when the chemical or waste material exhibits properties that require special handling. Such properties would include those identified with the TDI matter wastes involved in this accident, such as temperature and heating effects, means of self-reaction, and the byproducts of reaction, including the generation of gases and product expansion.

In the Safety Board's view, both parties to the transport of a hazardous material have information vital to its safe transfer. The producer/shipper has detailed knowledge about the properties of the chemical or waste material, while the consignee/end-user has specific information about the transfer facilities at the destination. Ideally, the result of the collaboration between the producer/shipper and consignee/end-user should be the development and implementation of specific, written transfer procedures that address each unique property of the chemical or waste material in the context of the physical layout of a given plant or facility.

The importance and effectiveness of such cooperation is evidenced by what happened when the TDI waste materials had to be moved after the Clymers accident took place. Following the accident at the Essroc plant, Olin and the waste disposal companies that were contracted to unload the remaining tank cars at a transfer facility in Deer Park, Texas, jointly developed comprehensive, written procedures that established viscosity and temperature limits and called for nitrogen sparging. Consequently, the transfer and offloading took place without incident.

Therefore, the National Transportation Safety Board makes the following safety recommendation to the Lyondell Chemical Company:

Collaborate with applicable producers, shippers, consignees, and end-users in the development and implementation of specific and written procedures for the loading or offloading of any chemical or waste material from a railroad tank car, highway cargo tank, or other bulk transportation vessel when the chemical or waste material exhibits properties that require special handling or processing during the loading or offloading operation. (I-01-05)

The Safety Board also issued safety recommendations to the Federal Railroad Administration, the Research and Special Programs Administration, the Railway Progress Institute, the Association of American Railroads, the Essroc Cement Corporation, the Olin Corporation, and CP Recycling, Inc., and Affiliated Companies. In your response to the recommendation in this letter, please refer to Safety Recommendation I-01-05. If you need additional information, you may call (202) 314-6170.

Acting Chairman CARMODY and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in this recommendation.

By: Carol J. Carmody
Acting Chairman