

Avoiding Unwanted Chemical Reactions

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PURPOSE

This Bulletin provides information on the avoidance of unwanted chemical reactions during laboratory and other work activities. Unanticipated and uncontrolled chemical reactions could adversely impact operations at Department of Energy (DOE) facilities.

BACKGROUND

On May 1997, a run-away chemical reaction occurred in a small tank at the DOE Plutonium Reclamation Facility at Hanford. The resulting explosion destroyed the tank and the room where the tank was located and created a toxic release. While such a serious chemical accident has not since occurred, unwanted chemical reactions on a smaller scale happen often throughout the DOE complex.

DOE records show 24 occurrences of unwanted chemical reactions over the past 5 years, including 3 injuries and 4 near misses where chemical vessels exploded or ruptured. Furthermore, there were 16 additional reports of safety concerns for chemical reactions due to the presence of shock sensitive chemicals and potential mixing of incompatible chemicals.

PRUDENT PRACTICES FOR WORKER PROTECTION AND MINIMIZING UNEXPECTED REACTIONS

- Employees working with chemicals must know and understand the hazards involved with their tasks.
- Consult a subject matter expert (SME) in chemical safety before performing work involving chemicals or modifying existing chemical work.
- Know what chemicals are being mixed, packaged, or stored.
- Examine materials or chemicals for potential incompatibilities prior to combining them:
 - Material Safety Data Sheets (MSDS) for materials may not identify all hazards encountered upon mixing or blending.
 - Chemical reactivity tables or worksheets do not always determine all chemical reactions or incompatibilities.
- Be aware that materials can become highly reactive if exposed to the right conditions.
- Suspect, unlabeled, and expired chemicals should not be used unless reviewed and approved by a SME.
- Avoid storing incompatible chemicals together.
- Keep all chemicals, especially flammables, oxidizers, reactives, and organic peroxides, away from heat and ignition sources.
- Use administrative and engineered controls before resorting to personal protective equipment (PPE) for worker protection.

TIME, TEMPERATURE, SHOCK SENSITIVE CHEMICALS

Chemicals may be subject to long term changes in concentration or degradation. Chemicals in the shut down process equipment in the 1997 Hanford incident concentrated over time, which in turn led to the accident. Some chemicals may develop additional hazards upon prolonged storage. Time-sensitive chemicals may become shock sensitive through drying, decomposition, or slow reactions with oxygen, nitrogen, or the container. Other chemicals may generate toxic gases.

If you find suspect or shock-sensitive chemicals that are outdated, immediately contact your supervisor and your organization's Safety or Hazardous Materials department. **DO NOT TOUCH OR MOVE SUSPECT CHEMICALS.**

Maintain a current inventory of chemicals with time-, temperature-, and shock-sensitive hazards that tracks locations, inspection dates, etc., from procurement through disposal. Include any chemicals created on-site and those not acquired through the acquisition process. Ensure that employees are adequately trained on the hazards, safe working methods, and emergency procedures for special hazard chemicals. Establish criteria and procedures for the safe and timely disposal of such chemicals.

ADDITIONAL SOURCES OF INFORMATION

- Your Safety and Health Office
- Information on DOE website:
 - (1) *Safe Management of Shock-Sensitive Chemicals and Management of Time Sensitive Chemicals, parts 1, 2 & 3:* http://www.hss.energy.gov/HealthSafety/WSHP/chem_safety/library/Doe_reg.html
 - (2) *Mixing and Storing Incompatible Chemicals:* http://www.eh.doe.gov/web/oeaf/lessons_learned/ons/sn9701.html
 - (3) *Management of Chemical Reactivity Hazards:* <http://www.knovel.com/knovel2/Toc.jsp?BookID=898>

SUMMARY

Do a thorough analysis for chemical properties and incompatibilities before working with the chemicals involved.

If you have any questions, please contact Dr. Bill McArthur by telephone at (301) 903-6061 or at bill.mcarthur@hq.doe.gov.

(Signed)

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PREVENT EVENTS

Learning from Industry Experience

PREVENT EVENTS is intended for use by personnel during morning meetings, pre-job briefings, and work unit meetings to communicate key industry experience.

Management:

1. Do we have expertise in chemical safety?
2. Do we have a written program and procedures to address the life cycle management of chemicals?
3. Do we have a site inventory tracking of time and temperature sensitive chemicals?
4. Do we have all the necessary MSDS and a method to track updated data sheets?
5. Do we perform scheduled routine chemical inventory walk-through of our facilities to check for unlabeled, unaccounted, and suspicious chemicals?
6. Is our safety department trained in chemical safety and know how to handle shock-sensitive materials?
7. Are chemical workers and laboratory personnel given the proper chemical safety training?
8. Have we made available to our chemical workforce and research staff the necessary PPE?

Supervisors and Workers:

1. Have we done a job hazard analysis that included possible chemical reactions?
2. Do we have the MSDS for all chemicals and is there a need to contact the supplier for more information?
3. Whom can we contact for additional chemical safety information?
4. Do we wear face shields over our safety goggles in areas where the chemical vessel might rupture and splatter its contents?
5. Who do we notify if we find crystallized formations in bottles of chemicals?
6. Do we report any unlabeled bottles of liquids or materials?
7. Have all employees for the job been properly trained?

