

Questions & Answers

Hydrolysate

What is hydrolysate and where does it come from?

The Pueblo Chemical Agent-Destruction Pilot Plant, known as PCAPP, will safely destroy the Pueblo chemical weapons stockpile by employing a chemical neutralization process. There are two types of blister agent, known as “mustard,” in the Pueblo stockpile: 98 percent of the stockpile is distilled mustard, or “HD”; and 2 percent is mustard known as “HT.” HT mustard is a mixture of HD and T, a mustard compound similar to HD with a lower freezing point.

Both types of mustard agent are drained from projectiles, fed into reactors, and mixed vigorously with hot water and sodium hydroxide, resulting in an irreversible chemical reaction in which the mustard is destroyed and a byproduct called hydrolysate (pronounced high-DRAWL-ih-sate) is formed. Hydrolysate is tested to ensure it contains no detectable mustard agent.

The hydrolysate produced by the neutralization of both types of mustard is a muddy-looking liquid that is approximately 90 percent water and salts (mainly sodium chloride). HD mustard hydrolysate contains an organic chemical called thiodiglycol (pronounced THIGH-oh-die-GLY-kol), while HT mustard hydrolysate contains thiodiglycol and a similar compound, T-alcohol. Both hydrolysates may also contain traces of impurities such as heavy metals and various organics that were in the mustard agent, but not destroyed by the neutralization process.

How much hydrolysate is expected to be generated by the Pueblo facility?

PCAPP is expected to generate an estimated 8,400,000 gallons of mustard hydrolysate. This includes decontamination solution and processing treatment condensates.

Is hydrolysate considered a hazardous waste?

Hydrolysate is mostly water and is neither explosive nor flammable. It is, however, considered a hazardous waste because it was originally derived from mustard agent. This derivation causes it to be listed under the Colorado Code of Regulations as a Resource Conservation and Recovery Act (RCRA) waste, K901.

There are other characteristics that lead to hydrolysate being considered a hazardous waste. The presence of sodium hydroxide - a caustic - could make hydrolysate a hazardous waste if the pH level exceeded 12.5 (the level at which a waste is considered “corrosive”). The neutralization process designed for the Pueblo facility specifies a target pH of 12 for the hydrolysate; at that point, it could be considered non-hazardous. However, it would still have to be formally “de-listed” from the Colorado Code - as it was in Maryland - if it were to be considered a non-hazardous waste. Additionally, the likely presence of trace amounts of heavy metals, such as lead



A laboratory technician at the Aberdeen, Md., chemical agent disposal facility analyzes mustard agent hydrolysate.

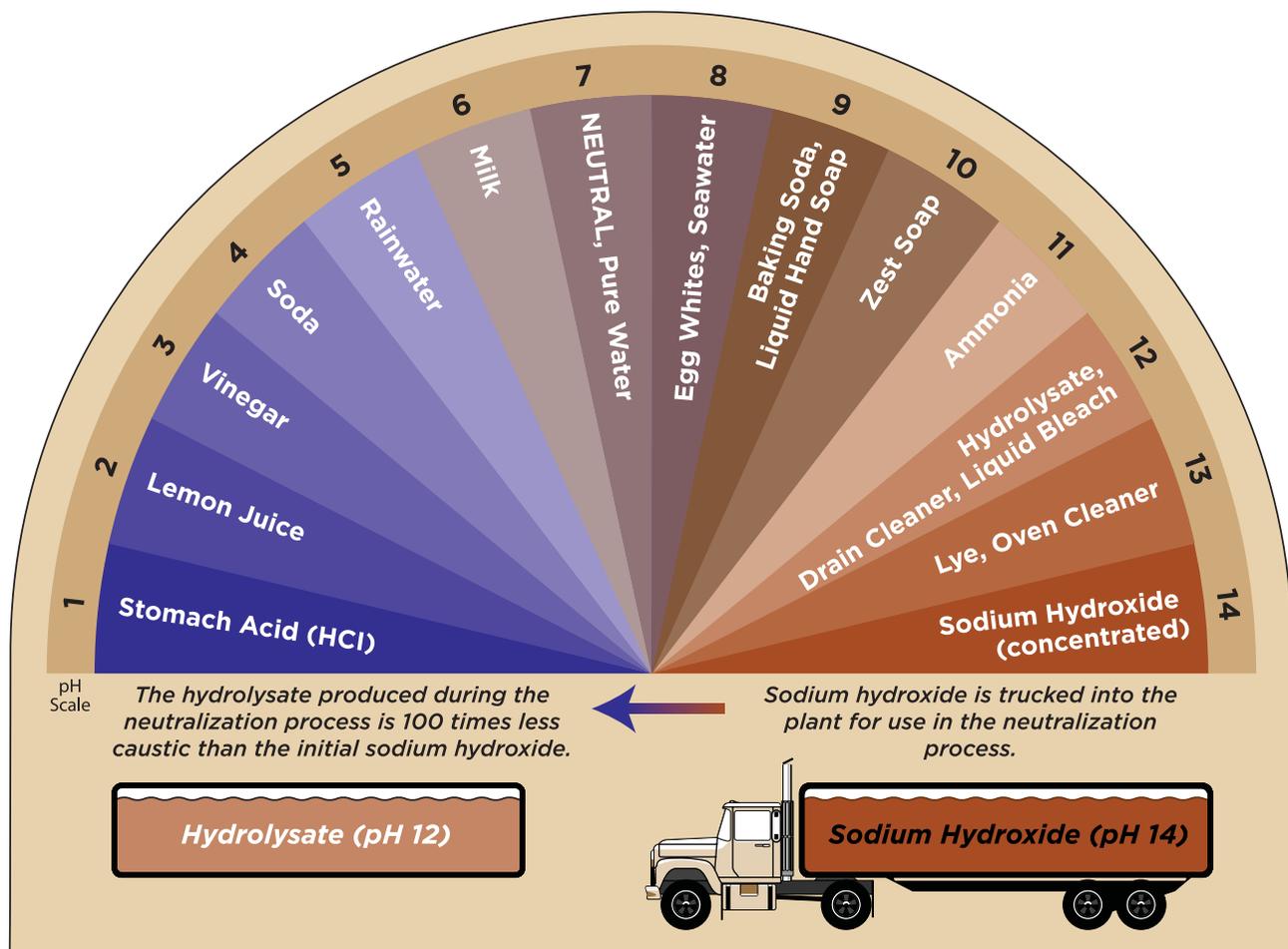
or chromium, in the hydrolysate will also serve to classify it as hazardous waste, according to U.S. Environmental Protection Agency standards.

Has hydrolysate ever been tested for toxicity?

Yes. As part of the extensive design testing for both the Aberdeen, Md., and Pueblo facilities, mustard hydrolysate was tested for toxicity. The testing concluded that the hydrolysate does not demonstrate any acute inhalation, oral or dermal toxicity to humans. It is slightly toxic to tested marine organisms and, because it is as salty as seawater, it is toxic to freshwater organisms.

How does hydrolysate compare with other potentially hazardous compounds?

Mustard hydrolysate will have a pH of approximately 12, making it comparable to commercial drain cleaner, which also has a pH of 12. (The pH scale is logarithmic with 7 being neutral and 14 very caustic.) The pH of seawater is roughly 8; liquid hand soap is 9 to 10; household ammonia is 11.5; liquid bleach is 12; and household lye is 13.5. Sodium hydroxide, which is mixed with the hot water in the neutralization process, has a pH of 14. So, in other words, hydrolysate is about as caustic as drain cleaner and liquid bleach, but at least 100 times less caustic than the sodium hydroxide that will be trucked into the plant for the neutralization process. The tanker trucks that would ship the sodium hydroxide into PCAPP hold 4,500 gallons. If PCAPP were operating 24 hours a day, seven days a week, it would need enough sodium hydroxide to fill 1.6 tanker trucks



per day (equivalent to 11.2 trucks per week or 584 trucks per year). Future budget restraints could impact PCAPP's operations schedule and as a result, would alter these estimates.

In a transportation risk assessment for mustard hydrolysate, Argonne National Laboratory concluded that "shipments of HD (mustard) hydrolysate through a community are expected to be less hazardous than shipments of gasoline to local dealerships." This study is available on the Colorado Department of Public Health and Environment Web site at <http://www.cdphe.state.co.us/hm/pcd/pcdtransportassessment.pdf>.

What are *thiodiglycol* and *T-alcohol*?

Thiodiglycol, known chemically as dihydroxyethyl sulfide, is a commercial compound used extensively in the ink and paint industry. In its pure form, thiodiglycol is not considered by the U.S. Department of Transportation to be a hazardous material, and hazard warning placards or labels are not required. *T-alcohol*, a product of neutralizing HT mustard, is a similar organic compound that, like *thiodiglycol*, is highly biodegradable.

How do you dispose of hydrolysate?

The disposal of hydrolysate is accomplished by a biotreatment process, similar to that employed by municipalities across the country in the treatment of sewage. The hydrolysate is pumped into large treatment tanks containing microbes that digest and break down the solution. Water released from the process is recycled, leaving various salts and biosludge. The biosludge, which is made up of microbe waste products and other bacterial matter, is filtered to remove water and shipped to a permitted landfill.

Current plans call for PCAPP to have its own biotreatment facility where the hydrolysate will be treated on site. However, because biotreatment is such a common industrial waste treatment process, if the plant's hydrolysate could be treated by a commercial facility, there is the potential for significant savings in not having to build and operate a biotreatment facility here. The Aberdeen Chemical Agent Disposal Facility in Maryland safely shipped more than 6 million gallons of mustard hydrolysate without incident to a commercial facility in New Jersey and completed destruction of its stockpile almost two years ahead of the original schedule.

What type of transportation would be required if Pueblo were to ship hydrolysate off site?

If hydrolysate from the Pueblo plant were shipped off site for treatment at a commercial facility, it would require approximately 1,400 tanker truck loads, each of about 6,000 gallons, or roughly 280 rail tank car loads, each of roughly 30,000 gallons. If rail shipment were used, tanker trucks might have to transport the hydrolysate from the plant to the rail head, a distance of some 20 miles. Hydrolysate shipment by road would equate to roughly two truck loads a day, seven days a week, for approximately 24 months. By rail, it would mean roughly three tank car loads a week for 24 months.



Hydrolysate, which is mostly water and thiodiglycol, is shipped in tanker trucks driven by specially trained operators.

If hydrolysate were shipped off site for treatment at a commercial facility, what emergency response measures would be required?

Hydrolysate shipments would be classified and shipped as RCRA hazardous waste. Emergency responders are trained to handle spills of hazardous materials in accordance with the U.S. Department of Transportation's "Emergency Response Guidebook." If a tanker truck or rail car carrying hydrolysate were to spill, in most cases responders would follow Guide 171, "Substances - Low to Moderate Hazard." In cases where the hydrolysate is caustic (pH greater than 12.5), they would follow Guide 154, "Substances - Toxic and/ or Corrosive, Non-Combustible." In general, both guides call for isolating the area for at least 150 feet, keeping unauthorized personnel away, staying upwind, ventilating enclosed areas and wearing protective clothing. Emergency response actions would also include containment and appropriate cleanup of the spill. No additional special training or equipment for emergency responders would be required.

Has it already been decided that hydrolysate from the Pueblo facility will be shipped and treated off site?

No. While the off-site shipment and treatment of hydrolysate remains an option under study for PCAPP, the systems contractor, Bechtel Pueblo, has been directed to continue designing a biotreatment facility for treating the hydrolysate on site. As this and other cost reduction options are studied, the PCAPP government/contractor team is committed to continued discussion with the Colorado Chemical Demilitarization Citizens' Advisory Commission and other interested members of the Pueblo community.

For More Information:

Pueblo Chemical Stockpile Outreach Office

104 West B Street

Pueblo, CO 81003

(719) 546-0400

PuebloOutreach@iem.com

U.S. Army Pueblo Chemical Depot Public Affairs Office

(719) 549-4135



www.pmacwa.army.mil