Blue Grass Chemical Agent-Destruction Pilot Plant

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Hydrolysate Overview

The Blue Grass Chemical Agent-Destruction Pilot Plant, known as BGCAPP, is being built to safely destroy the chemical weapons stockpile at the Blue Grass Army Depot near Richmond, Ky. The stockpile consists of blister agent (H, also known as mustard) in projectiles and nerve agent (GB or VX) in projectiles and rockets.

The process that will be used to destroy the chemical weapons stockpile is neutralization followed by supercritical water oxidation, or SCWO. During the neutralization process, munitions will be taken apart and the chemical agent is drained and separated from the energetics, which include explosives and propellants. The chemical agent is mixed vigorously with hot water and sodium hydroxide which destroys, or neutralizes, it. The energetics are neutralized in a similar process.

The neutralization process will produce a variety of secondary wastes that will require additional treatment including metal parts, non-metallic debris and spent decontamination fluids. Additionally, the byproduct from neutralization of the chemical agents and energetics is caustic wastewater, known as hydrolysate, which will also require further treatment and processing. It is expected that BGCAPP will generate more than 6 million gallons of hydrolysate during destruction operations.

Hydrolysate Defined

As each chemical agent is destroyed at BGCAPP in separate campaigns, a different type of hydrolysate will be produced – mustard hydrolysate, VX hydrolysate and GB hydrolysate. The destruction of energetics will also produce a unique type of hydrolysate.

Hydrolysates are classified as hazardous wastes under the Resource Conservation and Recovery Act. They are classified as such because they are byproducts of the destruction of a chemical warfare munition, because they may contain heavy metals and because they have corrosive properties.

The corrosivity of hydrolysates can be compared to other chemicals using the pH scale, which is logarithmic with 7 being neutral and 14 being very caustic, or corrosive. Mustard hydrolysate has a pH of approximately 10-12, making it comparable to commercial drain cleaner or liquid bleach. Both VX hydrolysate and GB hydrolysate have pH of approximately 12, while energetic hydrolysate has a pH of 11-13, as does oven cleaner. To make further comparisons, the pH of seawater is roughly 8; liquid hand soap 9 to 10; household ammonia is 11.5; drain cleaner and liquid bleach are both 12; and household lye is 13.5. As a result, hydrolysate, like many household products, can be harmful if it comes into contact with the skin or eyes and may harm the respiratory or gastrointestinal tracts if inhaled or ingested.

Treatment and Disposal of Hydrolysates

Following the chemical agent neutralization process, hydrolysates are verified to ensure complete chemical agent destruction. Hydrolysate produced by energetic processing is also verified to make certain that energetic material and chemical agent are destroyed.

However, because the hydrolysates contain precursors, or ingredients, that can be combined with other materials to create chemical agent, a secondary treatment process is required. Current plans for the secondary treatment of all the BGCAPP hydrolysates involve a process known as SCWO. During SCWO, energetic and chemical agent hydrolysates are fed to SCWO units to destroy the organic materials. In the SCWO units, the hydrolysates are subjected to very high temperatures and pressures, breaking them down into carbon dioxide, water and salts. The salts are condensed by reverse osmosis and shipped off site to a permitted facility for disposal while some of the water is recycled back into the pilot plant and reused as part of the destruction process. The remaining water from the reverse osmosis process is also shipped off site to a permitted facility for disposal.

Although SCWO is the current secondary treatment process, the BGCAPP team will continue to seek opportunities for treating hydrolysate in a manner that balances cost, schedule and performance but that does not compromise the safety of workers, the community and the environment.

A Partnership for Safe Chemical Weapons Destruction

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