



Biotreatment Process

The [Pueblo Chemical Agent-Destruction Pilot Plant](#), known as PCAPP, safely destroyed a stockpile of chemical weapons stored at the [U.S. Army Pueblo Chemical Depot](#) (PCD). A two-step technology – [neutralization followed by biotreatment](#) – was the process selected to destroy the chemical agent stored at PCD.

The Program Executive Office, Assembled Chemical Weapons Alternatives, was responsible for the safe and environmentally compliant destruction operations of the U.S. chemical weapons stockpile in Colorado and the Blue Grass Army Depot in Kentucky, by the [Chemical Weapons Convention](#) treaty commitment of Sept. 30, 2023. U.S. public law mandates stockpile destruction by Dec. 31, 2023.

Neutralization

During the neutralization process, munitions were taken apart and energetics (explosives and propellants) were removed. The chemical agent was drained, and the munitions bodies were rinsed. The agent was then mixed vigorously with hot water and sodium hydroxide, which destroyed or neutralized the agent. The resulting wastewater product, known as [hydrolysate](#), was held and tested to ensure agent destruction before proceeding to secondary treatment. The process was the same during the 105mm and 155mm campaigns.

Biotreatment

Following confirmation of agent destruction, the hydrolysate was treated in the Immobilized Cell Bioreactor (ICB) system – a system composed of 16 rectangular reaction tanks. Each tank is an aerobic, fixed-film bioreactor packed with two-inch polyurethane foam cubes where biological organisms reside.

Four reactors were grouped together to form an ICB module. Each module was equipped with a feed tank, aeration system, nutrient addition system, pH control system, effluent tank and an off-gas treatment system. A mix-culture of bacterial microorganisms attached to the ICB foam cubes break down thiodiglycol, also called TDG, and other organics in the



Sandwiched between the various immobilized cells in the PCAPP bioreactors is an assortment of polyurethane foam cubes, in which the wastewater-eating microbes reside.



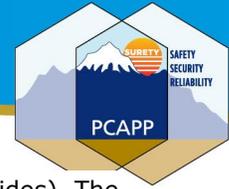
Thriving microbes inside the bioreactors treat hydrolysate, the wastewater product resulting from the chemical agent neutralization process.

Pueblo Chemical Stockpile Outreach Office
104 W. B St. Pueblo, Colorado 81003
(719) 546-0400 • pueblooutreach@jem.com

Pueblo Chemical Agent-Destruction Pilot Plant Public Affairs
(719) 549-4959

U.S. Army Pueblo Chemical Depot Public Affairs
(719) 549-4135





hydrolysate, converting them to carbon dioxide, water and minerals (chlorides and sulfides). The resulting effluent (biotreated water) was transferred to three Brine Concentrator Feed Tanks.

Environmental Conservation

Chemical weapons destruction at PCAPP included the conservation of water, a precious commodity in Colorado's arid terrain. During its life cycle, the Pueblo plant recovered, recycled and reused the equivalent of 80 percent of its water.

Brine Reduction System

The Brine Reduction System, or BRS, played an important role in PCAPP's conservation efforts. It was a process that incorporated three technologies: evaporation, crystallization and solids dewatering. Biotreated effluent was held in the Brine Concentrator Feed Tanks prior to pumping it to the BRS for further processing. An 86-foot-tall evaporator was used to boil water from the biotreated effluent and recover the water through condensation. The water was filtered and then recycled back into the plant.

After evaporation, the concentrated brine was pumped to a crystallizer to further reduce the brine volume and to prepare this salt slurry for filtration. With additional evaporation in the crystallizer, the dissolved salt concentrations increased to a critical point where salt crystals formed.

As in the evaporator, the water vapor was condensed and recovered water was filtered and sent to the Process Water Tank. The salt crystals and other solids in the concentrated slurry were filtered out and compressed. The resulting filtered "salt cake" was shipped to an off-site permitted hazardous waste disposal facility. Approximately 5,000 tons of salt cake were expected to be produced during the life of the project.

Secondary Wastes

Secondary wastes, which include both solid and liquid products coming from PCAPP's [Static Detonation Chamber](#) (SDC), were stored in either a less than 90-day hazardous waste accumulation area or a permitted storage area, pending shipment to Treatment, Storage and Disposal Facilities for further treatment and/or ultimate disposal.



The Immobilized Cell Bioreactors located on the PCAPP site use common microbes to treat hydrolysate.



The Brine Reduction System is the final stage of the PCAPP biotreatment process. A secondary waste of dried salt cakes are shipped off-site to a permitted hazardous waste disposal facility.