

DEPARTMENT OF THE ARMY

INFORMATION PAPER

January 31, 2006

SUBJECT: Military Sea Disposal Operations Near Hawaii

The Army and its sister Services are conducting an archive search of historical records on the disposal of military materials at sea, including near Hawaii. This review includes records at the National Archives and studies and survey reports on sea disposal sites. A brief summary of the findings to date is provided below.

1. The Army is focusing its initial research on identifying sea-disposal sites of Chemical Warfare Materiel (CWM) and conventional munitions in and around the Hawaiian Islands. Personnel with specific expertise in chemical and conventional munitions are reviewing records at the National Archives at both College Park, Maryland and in Washington, District of Columbia.

2. In 1944, War Department and Service procedures required sea disposal sites be at least 300 feet deep and 10 miles from shore. However, in 1945, the Department revised that policy, requiring disposal sites to be at depth of at least 600 feet and 10 miles from shore, unless a deeper site was found closer to shore. A 1946 War Department circular assigned the Army Chief of Transportation responsibility for the selection of sites and methods of operation for sea disposal, and required that such operations be coordinated with the Naval District Commandant. This circular revised the disposal depth to 6,000 feet for chemicals and 3,000 feet for other explosives and ammunition. In an April 24, 1945 memorandum, the Chief of Naval Operations (CNO) instructed all Navy and Coast Guard commands to establish and record the locations of disposals of all "explosives, ammunition, and chemical munitions." The CNO also required that disposal sites be located outside regular shipping lanes, fishing grounds, submarine operating areas, and well away from ocean cables. Additionally, locations were reported to the Government Hydrographic Office, which, in turn, used the information to post warnings to mariners.

3. National Oceanic and Atmospheric Administration (NOAA) nautical charts indicate four explosive material disposal sites in waters off the Hawaiian Islands. A November 14, 1945, memorandum from the Commandant of the 14th Naval District, Pearl Harbor, established these locations as disposal sites for "explosives, ammunitions, and chemicals." The Army is working to obtain documentation verifying the locations and types of materiel disposed of within these charted areas.

4. Information on Chemical Warfare Material disposals:

a. A 2001 Army report identified three CWM sea-disposals near Hawaii between 1944 and 1945. The Army is in the process of verifying documentation about the disposals and expects to complete this effort in early 2006.

b. Based on its review, the Army has assembled the following CWM related documentation:

(1) An inventory of CWM, to include the identification of obsolete, unserviceable and leaking munitions disposed of from 1925 to 1948. The large quantity sea-disposals only occurred between 1944 and 1946. (Only mustard, lewisite, hydrogen cyanide and cyanogen chloride appear to have been disposed of at sea near Hawaii.)

(2) Coordinates of sea-disposal sites from ships logs. These include the logs of Landing Ship Medium (LSM) 264, which participated in a 1945 Hawaiian disposal operation, and its two U.S. Coast Guard cutter escorts. LSM 264's log contains contemporaneous notes that may verify material disposed and the disposal coordinates. The Army is attempting to obtain the logs for the other ships involved in disposal operations. Some of the correspondence the Army reviewed suggests that a disposal occurred in 1944, pre-dating the earliest documented disposal site, but the disposal may have occurred at one of the sites later approved for disposal.

5. Information on conventional munitions:

a. Other records the Army has reviewed indicate that the military used water targets for ground-based artillery in Hawaii, Army Air Corps aerial bombing, and military training operations on Oahu from 1925 to 1945. These records also include documentation about the sea disposal of conventional munitions.

b. In 1996, the Army completed an investigation, which included sonar and underwater video surveys, of the ocean area between 2.25 and 6 miles south of Oahu. The surveys identified 46 munitions (small arms, large naval artillery shells, depth charges, a mine, a bomb) and components on the ocean floor at a depth of 820 to 1,740 feet. This area also lies within the firing range fans from Fort Weaver and Alum Point.

c. In 2002, the Army surveyed an area near the Waianae sewage outfall--referred to locally as Ordnance Reef--and identified over 2,000 military munitions at depths ranging from 15 to 240 feet, with the majority of munitions observed at depths below 60 feet. The closest items are approximately ¼-mile from shore with the bulk located over ½-mile from shore.

d. During recent meetings in Hawaii, the staff from the Hawaii Undersea Research Laboratory, University of Hawaii, provided numerous photographs of munitions taken along the underwater sea wall near Barber's Point, at a depth of approximately 1,000 feet or deeper.

6. Other background information:

a. The Navy collected data from deep water disposal sites (three in the Atlantic in the early 1970's and one in the northern Pacific), two of which were used for chemical weapons disposal. Subsequent monitoring was performed at one site annually from 1971 through 1975. The Navy found no evidence of any environmental impacts at any of these sites.

b. DoD is currently reviewing past scientific studies, both US and international, on the effects

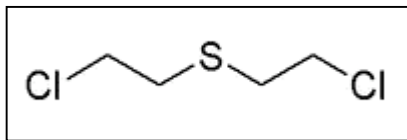
of seawater on chemical munitions and the potential impacts of sea disposal on marine environments. This research, the will enable us to gain a better understanding of the current condition of materiel disposed of at sea, and support informed decisions on next steps to be taken to address these sites. Several other countries, notably England and Australia, have determined that the best approach is to document locations on nautical charts, and restrict access/activities at these sites, and provide safety education to maritime and coastal communities.

c. Chemical agents degrade over time into less toxic materials. The rate of degradation varies from minutes to months based on the agent involved and environmental conditions. (See attachment.)

Attachment

Attachment: Information on the Properties of Chemical Agents Disposed of in Hawaii

Mustard



Mustards are classified as blister agents and are a class of compounds characterized by the presence of a central sulfur atom with chlorine atoms on the ends of an organic backbone. Mustards have a relatively high melting point and will form a solid mass in the colder temperatures found at ocean depths. They are generally

heavier than seawater and are only slightly soluble in water.

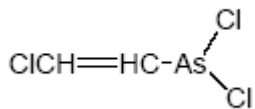
The rate of hydrolysis or degradation of Mustard from exposure to seawater is nearly the same as the rate of dissolution, as a result, no more than a few parts per million of the mustard will be present in the water surrounding the material at any given time. The ultimate products of hydrolysis are thiodiglycol and hydrochloric acid; the former is non-toxic and the latter is neutralized by seawater.

In quiet (e.g., little or no current) sea conditions, hydrolysis occurs at the mustard and water interface. A hard polymer layer can form at this interface that shields the bulk of the Mustard from hydrolysis reactions. Because of this, bulk Mustard could remain stable underwater for years in zones where there is little current or turbulence. Nonetheless, at temperatures as low as 5°C, dissolved mustard is reduced to 1/1,000 of its original mass in about 30 hours, and to 1/1,000,000 (1/M) of its original mass in about 12.5 days.

An intermediate in the hydrolysis process is β -chloroethyl hydroxyethyl sulfide, which is also toxic. The rate of hydrolysis of this intermediate is comparable to that of Mustard. Because a reduction in toxicity must consider the hydrolysis of both Mustard and its intermediate, a 50 percent reduction in toxicity of dissolved mustard requires about twice the half-life of the original product. At temperatures of 5°C, then, a reduction of mustard to 1/M of its original toxicity would likely require 25 to 30 days.

In summary, the life of Mustard and its degradation products in seawater is determined by the rate of dissolution, which is a function of temperature, degree of agitation, and velocity of currents. Once Mustard is dissolved, the hydrolysis proceeds rapidly to innocuous products. The concentration of hazardous materials in any given area will likely be very small because of diffusion, currents, and the rapid rate of hydrolysis.

Lewisite (L)



Lewisite is an arsine compound that is classified as blister agent. Though its mode of action is somewhat different from that of Mustards, the effects are similar, though faster in action.

Lewisite has a significantly lower melting point than Mustard and will generally be found as a liquid at temperatures found at ocean depths. Lewisite is also somewhat denser than the Mustards. The solubility of Lewisite is not a significant factor in its fate and transport, since it is hydrolyzed instantaneously in water, through which it loses its blister agent properties.

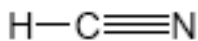
Lewisite was manufactured in the United States prior to World War II. After 1943, the U.S. military ceased Lewisite production, except for small quantities produced for testing and identification. In 1948, the bulk of the 20,000 tons manufactured during World War II were disposed of at deep water locations in the Atlantic and Pacific Oceans.

Lewisite normally contained stabilizers to prevent its decomposition from reaction with the iron in munitions. Lewisite, in its common form, actually consists of a mixture of several arsenic isomers.

Lewisite is 36 percent arsenic. The hydrolysis of Lewisite involves a number of intermediate, reversible steps, first rapidly hydrolyzing to form chlorovinylarsine oxide (a blood toxin) and hydrochloric acid, and resulting in a final product of polymerized arsenic oxide.

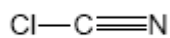
In summary, Lewisite released into the marine environment will quickly lose its blister agent (vesicant) properties through hydrolysis (exposure to seawater), resulting in a net increase in arsenic concentrations either in sediments (in the case of insoluble end products) or in solution.

Hydrogen Cyanide (AC)



Cyanogen chloride is a blood agent. Blood agents effect body functions by preventing the normal utilization of oxygen by the cells. Hydrogen Cyanide is a colorless liquid and was first used in 1916 during World War I. Salts of hydrogen cyanide are soluble in water. Hydrolysis is rapid in the presence of a base or basic salts. Toxic hydrogen cyanide is converted relatively easily into non-toxic formic acid and its sodium salt.

Cyanogen Chloride (CK)



Cyanogen chloride is a blood agent and a colorless gas. Cyanogen chloride was first used in World War I in 1916. It is converted to hydrogen cyanide in the body. In the 1930s, the United States developed stabilizers to inhibit the polymerization of CK. Cyanogen chloride remains stable for less than a month in canister munitions and can form explosive polymers.

Cyanogen chloride is quite soluble in water. The products of hydrolysis are hydrochloric acid and cyanic acid. These products are further converted to carbon dioxide and ammonium chloride. Because of its extreme volatility and relatively rapid rate of hydrolysis in water, CK is not expected to persist in seawater. Hydrolysis half-lives range from 1 min at 45°C to 10 hr at 5°C.