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DEMILITARIZATION OF CONVENTIONAL MUNITIONS STUDY FOR AIR, WATER AND SOLID WASTE NSWC INDIAN HEAD MD
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15. SUPPLEMENTARY NOTES

16. ABSTRACT This study was undertaken:

To review the technology in use by the military to dispose of obsolete, excess and unsafe explosives and propellants; to characterize, at least in a preliminary manner, the air, water and solid wastes generated during such operations; to identify technology in use or under development to control or eliminate the environmental insult from these operations; and to identify areas where additional research may be needed to more fully characterize the wastes or to develop needed pollution abatement technology.

The study found that four basic "demilitarization" techniques are in common use: washout or steamout; confined detonation or burning in a rotary kiln; open burning; and open demolition. More sophisticated processes are under development.

Air pollution consists primarily of fine particulates and, to some extent, NO_x from burning or detonation operations. Control is being achieved with scrubbers and bag houses.

Water pollution, primarily as dissolved explosives or other components, arises during washout and steamout operations and, to a lesser degree, from the use of scrubbers. Recycle of wastewater is widely practiced as is the use of evaporative ponds. Newer technology is also under development.

Solid waste consists primarily of dunnage and scrap shells. Burning of combustibles, resale of scrap metal, and land disposal of sludges are common practices.

17. KEY WORDS AND DOCUMENT ANALYSIS

Subjects

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
1. Wastewater Explosives Waste Treatment Propellants Manufacturing 2. HAZARDOUS WASTES	Water Pollution Control Air Pollution Control Military Air Emissions	50 B 74 D

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	Activity					Product Capabilities																																								
	WPRE			LAP		Acids							Explosives								Propellants					Dry Assembly	Ingredients Used in Formulations																		
	Acid	Expl.	Prop.	Expl.	Prop.	Acetic Anhydride	Glacial Acetic Acid	Conc. Nitric Acid	Weak Nitric Acid	Conc. Sulphuric Acid	Oleum	DNT	TNT	NG	Tetryl	RDX	HMX	HGU	Primers	N	Single Base	Multi-Base	Solventless	Composite		Al	AP	$CaCl_2$	DNT	HMX	NC	NG	HGU	NH_4NO_3	Ammonium Picrate	Polybutadiene	Polyurethane	RDX	Solvents	THT	Wax	$NaNO_3$
Army Ammunition Plants																																														
Badger	x	x	x					x	x	x	x			x						x	x	x	x						x																
Cornhusker				x																																									
Holston	x	x				x	x	x	x							x	x												x				x				x		x	x					
Iowa				x															x							x				x							x		x	x					
Indiana	x		x					x	x	x										x	x																								
Joliet	x	x		x				x	x	x	x	x	x		x				x							x											x		x						
Kansas				x																						x											x		x						
Louisiana				x																																	x		x	x					
Lake City		x		x															x																										
Longhorn					x																					x	x								x									x
Lone Star				x																						x											x		x						
Milan				x																						x											x		x						
Newport	x	x						x	x	x			x																																
Radford	x	x	x					x	x	x	x		x	x						x	x	x	x	x								x													
Redstone					x																			x		x	x								x			x							
Sunflower								x	x	x										x	x	x	x																						
Volunteer	x	x						x	x	x	x		x																																
Navy Ammunition Plants																																														
NAD Crane				x																						x				x				x	x			x		x	x	x			
NAD Hawthorne				x																						x												x		x	x				
NCS Indianhead		x	x		x									x								x	x	x		x	x			x	x	x	x			x	x	x	x						
NAD Yc Alester				x																						x								x				x		x	x				
NIROP Magna		x		x	x									x										x		x	x			x	x	x					x		x						
NWS Yorktown				x																						x		x										x		x	x				
Air Force Ammunition Plants																																														
Plant 44																									x																					
Plant 77																									x																					
Plant 79					x																			x		x	x			x	x	x				x			x						x

Figure 1 - The Military Explosives and Propellants Industry

3. SCOPE

The scope of the study can be defined in terms of:

- o Military organizations,
- o Munitions,
- o Demilitarization processes,
- o Effluents, and
- o Treatment technology.

The military organizations are tabulated in Table 1. Demilitarization processes are described in Chapter II. Effluents and treatment technology are discussed in Chapters III-V.

TABLE 1. MILITARY DEMILITARIZATION INSTALLATIONS

U. S. Army Depots (AD)	U. S. Army Ammunition Plants (AAP)	U. S. Navy Installations
Anniston AD	Iowa AAP	NWSC Crane
Letterkenny AD	Ravenna AAP	NAD Hawthorne
Lexington-Bluegrass AD	Joliet AAP	NAD McAlester
Pueblo AD	Cornhusker AAP	NAD Earle
Navajo AD	Newport AAP	NWS Yorktown
Ft. Wingate AD	Longhorn AAP	NWS Seal Beach
Red River AD	Pine Bluff Arsenal	NWS Charleston
Seneca AD	Milan AAP	NTS ~~Kayport~~
Sierra AD	Kansas AAP	NOS Indian Head
Tooele AD	Lone Star AAP	
Umatilla AD	Volunteer AAP	
Savanna AD	Sunflower AAP	
	Holston AAP	
	Radford AAP	
	Indiana AAP	

NWSC - Naval Weapons Support Center	NTS - Naval Torpedo Station
NAD - Naval Ammunition Depot	NOS - Naval Ordnance Station
NWS - Naval Weapons Station	

a. "Demilitarization" is the process of rendering inert or removing the energetic ingredients contained in munitions which are defective, obsolete, unsafe, or otherwise no longer required in the military inventory. Demilitarization also includes removal of aging inert ingredients when the casings are desired for reuse for refill with new explosives or propellants.

similar enough to lend themselves to the same categorization used above:

ACTIVITY	DEACTIVATION FURNACE	WASHOUT	DETONATION	OPEN BURN
NWSC Crane	x	x	x	x
NAD Hawthorne	x	x	x	x
NAD McAlester	x	x		x
NAD Earle	x	x		x
NWS Yorktown		x	x	x
NWS Seal Beach			x	x
NWS Charleston	x		x	x
NTS Keyport	x	x		x
NOS Indian Head		x		

c. As mentioned, the AAP's demilitarization operations are minor; but they do exist, and they are summarized on the following chart:

ACTIVITY	DEACTIVATION FURNACE	WASHOUT	DETONATION	OPEN BURN
Iowa AAP	x	x	x	x
Ravenna AAP	x	x		x
Joliet AAP	x	x		x
Cornhusker AAP		x		x
Newport AAP	x	x		x
Longhorn AAP	x		x	x
Pine Bluff Arsenal	x	x	x	x
Milan AAP		x		x
Kansas AAP	x		x	x
Lone Star AAP	x		x	x
Volunteer AAP				x
Sunflower AAP				x
Holston AAP				x
Radford AAP	x			x
Indiana AAP				x

32. PLANNED EXPANSIONS

There are no major planned expansions of current facilities, since the demilitarization workload is currently diminishing and many of the present facilities, particularly washout plants, are in layaway; but there are a number of minor upgrading projects in progress, mostly to meet more stringent environmental

b. The above operations are typically carried out more or less remotely on automated disassembly lines designed especially for the job. Fixed artillery ammunition, for example, will be placed by hand into a "Vertical Pull Apart Machine" where it is clamped firmly into place. The machine rotates the munition behind a safety shield, and a pair of jaws grip the projectile and pull it forcibly from the cartridge case. The freed projectile is placed (usually by hand) into another clamping jig; and another jaw grips and unscrews the fuze, behind another safety shield. Fuzes go down one conveyor, de-fuzed projectiles down another, empty cartridge cases down still another; and the dumped propellant powder is collected into a bin by vacuum. It is the reverse of an assembly line.

c. The disassembly of smaller ammunition, such as 20-mm, is even more automated. Complete rounds are laid by hand on a conveyor belt which takes them behind a safety shield, clamps the cases firmly while forcibly bending the projectile sideways until it breaks free of the case, drops the projectile onto a second conveyor which takes it to a collection bin, drops the cases into a tumbling barrel where the propellant powder is shaken out and collected in a vacuum system, and finally drops the cases onto a third conveyor which takes them to another collection bin.

d. The components of the disassembly lines are all special items, known as "Ammunition Peculiar Equipment (APE)". There are hundreds of them, ranging all the way from hand-held clamps through conveyor and pullapart units to complete washout plants and radiographic trailers. They are listed and described in detail in an Army publication, "Army Equipment Data Sheets - Ammunition Peculiar Equipment, Technical Manual TM 43-0001-47," dated July 1975. (The Manual also lists ammunition peculiar equipment for purposes other than demilitarization, such as assembly, inspection, dud retrieval and the like.) (86)

e. The munition breakdown and disassembly operations are all purely mechanical, and they involve no air or water pollution discharges except for nominal amounts of dust and/or floor washdown. Many of them are located in buildings that do not even have water except in the personnel lounges.

EXAMPLE

7. APE-1300 WASHOUT PLANT

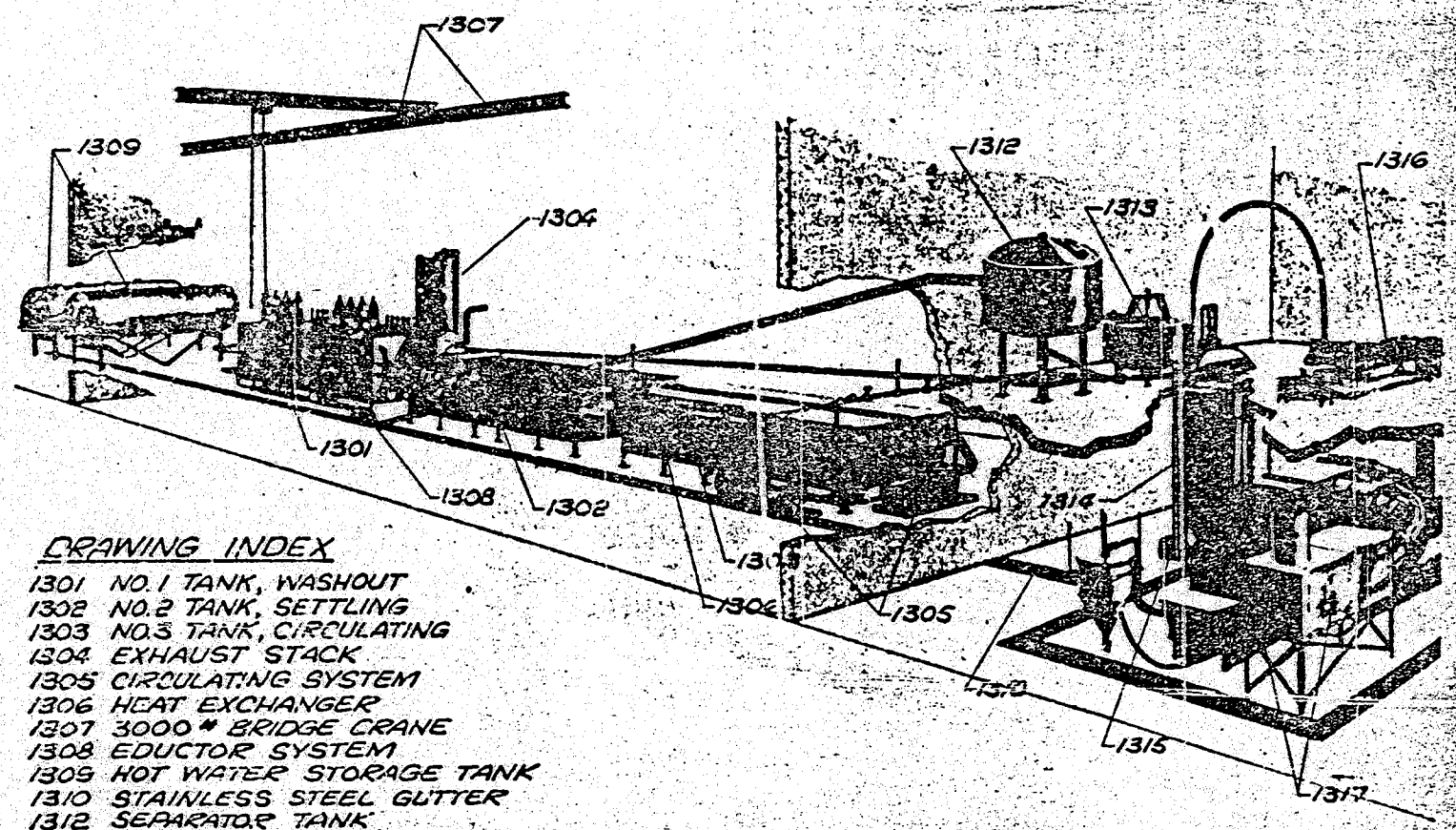
a. The Washout Plant is a standard APE item designed and specified in detail by the U. S. Army Ammunition Equipment Office (AEO) located at Tooele Army Depot. It consists usually of a 4500

square foot building (all of whose details are included in the specifications) containing a water heater, the wash racks proper, explosive reclamation and packaging sections, and water reclamation facilities. Basically, hot water is injected under ~90 psi pressure into the cavity of an opened and up-ended projectile or bomb, melting out the fill and washing the metal case clean. (Figures 1, 2, and 3)

b. In operation, ammunition items are placed vertically and open end down in holding racks, and hot water is jetted up into them at 90-125 psi to melt and wash out the explosive fill. The hot water is held at approximately 180°-205°F, a temperature which usually contemplates TNT as the energetic material in the explosive fill -- much lower would fail to melt the TNT, and much higher would lead to clogging of the flumes and filters. The molten TNT-water slurry is led to a settling tank where most of the water is separated for re-use. The molten explosive is pelletized by showering droplets forced through a perforated plate and through ambient cold water, and the solidified pellets are collected, dried and boxed for storage or shipment. The production rate of the standard AFP-1300 system is approximately 1400 lb/hr explosives, limited mainly by the capacity of the pelletizing unit. A modified washout system at NAD Hawthorne equipped with a belt flaker has an estimated capacity of 2000 lb/hr.

c. The recycle water is chilled to remove the excess dissolved explosive, filtered and sent to a holding tank for eventual feed back to the heating units. Ordinarily, no water is discharged from a washout plant while it is running (although some do feature an overflow equal in volume to the volume of explosive washed out). Instead, the water is continuously recycled to the washout section after being chilled and filtered to remove excess dissolved and suspended explosive. When a plant is shut down, the water inventory may be discharged to some disposal system or retained in the holding tank. At this writing, all the washout plants are planned to be equipped with carbon adsorption columns for final treatment of discharged water.

d. The empty metal munition cases are flashed at the burning ground or in a flashing furnace to destroy any remaining traces of explosive, and then sent to scrap metal reclamation. Occasionally, when the cases are needed for re-loading, they may be chemically cleaned to avoid heat warpage; but this procedure is unusual.

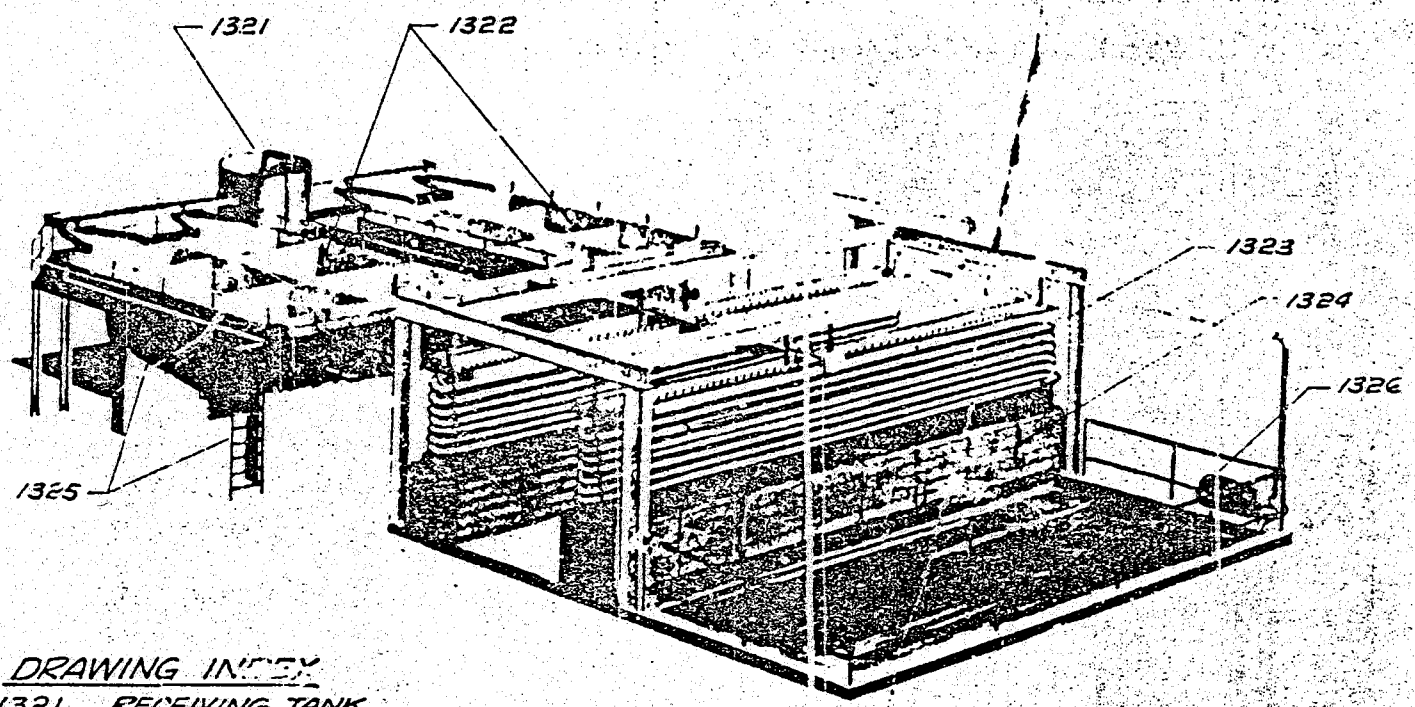


DRAWING INDEX

1301 NO. 1 TANK, WASHOUT
1302 NO. 2 TANK, SETTLING
1303 NO. 3 TANK, CIRCULATING
1304 EXHAUST STACK
1305 CIRCULATING SYSTEM
1306 HEAT EXCHANGER
1307 3000# BRIDGE CRANE
1308 EDUCTOR SYSTEM
1309 HOT WATER STORAGE TANK
1310 STAINLESS STEEL GUTTER
1312 SEPARATOR TANK
1313 DOPP KETTLE
1314 PELLETING TANK
1315 PELLET PUMP
1316 DEWATERING SCREEN
1317 DRYER

EXPLOSIVE WASHOUT PLANT

Figure 1 - APE 1300 Explosive Washout Plant Schematic Diagram. (130)



DRAWING INDEX

1321	RECEIVING TANK
1322	SETTLING TANK
1323	COOLERS
1324	FILTERS
1325	CATWALK & LADDERS
1326	PUMP, CENTRIFUGAL

EXPLOSIVE WASHOUT PLANT
WATER RECLAMATION SYSTEM

Figure 2 - APE 1300 Water Reclamation System. (120)

e. Loaded filter batts and unreclaimable dregs from the explosives settling tanks are disposed of by burning, either on a burning ground or in a suitable incinerator.

f. The APE-1300 Washout system has been demonstrated for explosive fills of TNT, Comp B (TNT-RDX), Tritonal (TNT-Al°), Amatol (TNT-NH_4NO_3) and Octol (TNT-HMX). The TNT, the Comp B and the Tritonal were successfully pelletized. The Octol solidified "too fast and too hard", but it could have been flaked or otherwise reclaimed. The Amatol was an experimental run; the system is not approved for ammonium nitrate-containing compositions because of corrosion of the brass fittings in the plant.

g. At this writing, most of the APE-1300 Washout plants are in layaway for lack of a workload. The older ones are being modernized by the addition of such refinements as W-bottom tanks to handle Comp B, twin settling tank eductors and water-flushed pump seals; and all of the plants are expected to be equipped eventually with carbon column final water filters.

h. The APE-1300 system is described in detail in an Army Technical Manual, "Operation and Maintenance - Ammunition Explosives Washout and Reclamation System - APE 1300," Revision No. 2, 1 February 1974. (5). Air pollution is discussed in Ch. III.

8. APE-1236 DEACTIVATION FURNACE

a. The APE-1236 "Deactivation Furnace" is a steel rotary kiln approximately 30 feet long and four feet in diameter. (Figures 4 and 5). The main body is a horizontal tube (four 60" sections bolted end to end) with side walls about 2-1/4 inches thick and with a spiral internal flight which acts like a screw conveyor in moving materials through the unit as the tube slowly rotates. Items such as small arms ammunition, artillery shell fuzes, emptied 20-mm cartridge cases and the like are fed to the furnace via a steel conveyor belt which carries them high above the mouth of the furnace and drops them down a chute into the feed end of the rotating tube. An oil or gas fired burner in the discharge end of the tube provides a flame and hot flue gases which sweep through the tube and up a stack mounted over the feed end. The temperature near the burner is about 1200°F; it is about 600-900°F in the middle sections and about 400-500°F in the stack.

b. As the items being demilitarized are carried through the tube by the spiral flight, any explosives they contain deflagrate or detonate as they reach their kindling or initiation temperatures.