

HAZARDOUS WASTE – COMBUSTION ENGINEERING

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INTRODUCTION

The industrialisation of the last hundred years makes a high standard of life possible and nobody would like to miss this way of life. But it is associated with problems: mercury and cadmium contamination in Japan in the sixties, accidents in Seveso (1976), Mexico City (1984), Bhopal (1984) and Basel (1986). In all cases we were confronted with toxic substances such as asbestos, dioxins, furans, halogenated hydrocarbons, heavy metals etc. Not only these industrial chemicals are dangerous or cause damage to man, fauna and environment. In addition to these industrial aspects in Germany we have to consider also military hazards.

The risks ensue from storage, intermediate storage, production facilities and destruction sites and hazards caused by army activities: The contamination of nature due to the release of substances like grease, oil, lubricants, waxes or detergents when using petrol stations or cleaning and maintenance facilities. Military hazards include major industrial hazards problems and it is thus important to discuss them.

In Germany we were the first in the world to have military sites investigated as regards contamination, wastes and hazards after the withdrawal of forces. These investigations were made by civil experts. After reunification e.g. the State Brandenburg took over 1 000 000 m³ waste from military sites:

- 75 % housing waste
- 15 % hazardous waste
- 5 % military hazards, which were not taken by the German community.

HAZARDOUS WASTE AND MILITARY HAZARDS

The hazards and risks from common and military waste can be extremely serious. They include industrial waste material as well as military waste materials. The assessment of the four essential aspects of waste is decisive for preventive measures: toxicity, amount, concentration and mobility.

Nevertheless, the difficulties of handling the waste materials are due to chemical and physical properties as well as to tactical and physiologic requirements of the military, as shown in Table 1.

Environmentally Relevant Chemicals

In the course of the industrial production of ammunition, propellants and explosive substances emerge which doubtlessly due to their quantity threaten the environment (1).

These are among others: antimony, arsenic, lead, chromium, copper, mercury, aromatic amines, trimethylenetri-nitroamine (Hexogen), hexanitrodiphenylamine, nitrobenzol, toluol, dinitrotoluene, trinitrotoluene, phenol, dinitrophenol, trinitrophenol, chlorate and perchlorate.

Nitrocompounds

Nitro compounds are of special importance because decomposition products like nitrosamines and others are carcinogenic. Fourteen decomposition products of the 2,4,6-trinitrotoluene (TNT) and hexanitrodiphenylamine alone are carcinogenic substances or classified as substances with well-founded

suspicion of causing cancer on the basis of animal tests or experience from clinical pictures in humans (2, 3, 4) (Table 2).

Chemical Warfare Agents

Chemical warfare agents which can be expected from World War II and earlier (Table 3) are the most dangerous chemicals because of their treacherous properties (5).

DECOMPOSITION OF INDUSTRIAL AND MILITARY HAZARDOUS WASTE

Worldwide there exist several concepts for the elimination of industrial and military waste, not only high standard, efficient plants. Table 4 shows possibilities offered by industrial processing.

Table 1. Military requirements for chemical warfare agents

Physiologic requirements include (among others)

- immediate effective high toxicity for man,
- the incorporation should not be noticed, this applies to agents which penetrate by the subcutaneous route
- evaporation enthalpy – $\Delta H \sim 0$, no characteristic smell,
- short latent period,
- long period of inertness.

Physical properties

- vapour density > air,
- high vapour pressure,
- low boiling point,
- resistant to explosion,
- thermal resistance.

Chemical properties

- high resistance to hydrolysis,
- low reactivity towards oxidation and reducing agents,
- inert to storing conditions (storage resistance).

Tactical requirements

- odourless,
- invisible,
- good permeation of protective devices facilities.

Table 2. Decomposition products of 2,4,6-trinitrotoluene (TNT)

Classification 1 ^a	Classification 2 ^b
4-aminodiphenyl	2,3-dinitrotoluene
	2,4-dinitrotoluene
	3,4-dinitrotoluene
	3-nitrodiphenyl
	4-nitrodiphenyl
	2-nitronaphtalene

^a Carcinogenic substances which may cause development of malignant tumours.

^b Carcinogenic substances which so far, according to the commission, proved carcinogenic only in animal tests. The classification of substances with a carcinogenic potential is based on the Hazardous Materials Ordinance (GefStV) and the Lower Toxic Unit List (MAK-List) of the FRG.