PROCEEDINGS

TENTH ANNUAL ENVIRONMENTAL SYSTEMS SYMPOSIUM

OCTOBER 16-17, 1979
CHARLESTON NAVAL BASE
CHARLESTON, S.C.

AMERICAN DEFENSE PREPAREDNESS ASSOCIATION

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PAPERS PRESENTED

at the

TENTH ANNUAL ENVIRONMENTAL SYSTEMS SYMPOSIUM

"MANAGEMENT AND CONTROL OF TOXIC AND HAZARDOUS

MATERIALS

AT

MILITARY INSTALLATIONS"

Sponsored by

ENVIRONMENTAL SYSTEMS SECTION,

CHEMICAL DIVISION

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NAVAL BASE

CHARLESTON, S.C.

OCTOBER 16 & 17, 1979

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SPEECH OF

GEORGE MARIENTHAL

DEPUTY ASSISTANT SECRETARY OF DEFENSE

(ENERGY, ENVIRONMENT AND SAFETY)

AT THE

AMERICAN DEFENSE PREPAREDNESS ASSOCIATION'S

TENTH ANNUAL ENVIRONMENTAL

SYSTEMS SYMPOSIUM

CHARLESTON NAVAL BASE

CHARLESTON, SOUTH CAROLINA

OCTOBER 16, 1979

It is a pleasure to be here today and address this Tenth Annual Environmental Systems Symposium. This year, my office had the opportunity to be involved in the formulation of the program. I am, therefore, very hopeful that you will find this meeting both valuable and interesting.

It seems that hardly a month goes by without some new story in the newspapers or on TV about a major chemical incident involving a hazardous or toxic material. A train derails and thousands of people are evacuated from their homes -- or a bulk storage tank is discovered to have been leaking and slowly leaching toxic chemicals into the aquifer -- or an abandoned chemical manufacturing site is discovered with stockpiles of improperly treated toxic chemical wastes -- or contaminants are found in the food chain -- such as the PBB problem in Michigan, or the PCBs in Idaho.

We, as a nation, are just now beginning to realize the long term health and environmental effects of many of the toxic and hazardous chemicals which resulted from the industrial revolution and proliferated in the name of economic progress. The communications media is now highly sensitized to this whole issue. Just last week, the award winning public broadcasting TV series, "Nova," opened its season with a two-hour special devoted exclusively to the environmental impact of the widespread use of PCB's and on the use of defoliants contaminated with dioxin. The Washington Post recently ran an article detailing the problems of an abandoned West German chemical plant. A child playing in the area died from exposure to those chemicals. So much for the importance of this symposium.

By way of overview, I would like to discuss with you today the Department of Defense's cradle to grave involvement with toxic and hazardous materials. DoD is a diverse industrial operation. Many of our thousands of installations are involved daily with many aspects of hazardous material management, including:

- o Procurement,
- o Production,
- o Research and Development,
- o Transportation,
- o Storage,
- o Worksite use, and
- o Disposal.

I will discuss each of these briefly with you this morning.

First, let's look at those toxic and hazardous materials which DoD purchases. For purposes of my discussion, toxic and hazardous materials are those defined in Federal Standard Number 313A. The menu is vast and mind-boggling; from paint removers to pesticides, adhesives to asbestos, fuels to fluxes, and polishes to propellants. The list goes on and on. We purchase basic raw materials, such as lead and beryllium, as well as commercial industrial products and reagent grade chemicals for use throughout the DoD complex. When you look at the tremendous variety and volume of various items purchased, you can see that DoD is probably the largest buyer of hazardous materials in the country. With that distinction, however, comes a corresponding responsibility.

In addition to those chemicals which we purchase, DoD also manufactures a variety of chemicals such as propellants and explosives, as well as high technology chemicals for specialized tactical applications. We need only look to the recent experiences of the private sector in the manufacture of vinyl chloride to realize the nature of our responsibility for worker safety and health.

Some chemicals are designed and developed for the express purpose of causing unreasonable risk of injury to health in the military environment. The premanufacturing notification rules of the Toxic Substances Control Act will help prevent the introduction of those chemicals into our society. Dr. Back, later this morning, will discuss the impact of the Toxic Substance Control Act upon the DoD R&D program.

With respect to the transportation issue, Defense owns and operates over a half a million wheeled vehicles, thousands of aircraft, and hundreds of ships. Thus, the safe transportation of toxic and hazardous materials to and on, our thousand facilities is of primary concern. We follow the lead of the Department of Transportation and comply with their regulations. Our safety record to date has been good. To help insure that hazardous items are shipped properly, the DoD has established a hazardous material information system. The system, which will be described later this morning, provides the DoD shipper with pertinent information for safe transport.

Storage of those items is an everyday occurrence in DoD. A multitude of hazardous items must be stored compatibly, for example, acids away from alkalies, oxidizers away from flammables. We must also protect personnel and the environment in the event of spills and fire.

Too often, we find instances where toxic and hazardous materials are stored outdoors and, as a consequence, their containers deteriorate. The fixes are long-term because they require military construction funds to complete. Progress is slow at times, but we are getting there. For example, the Defense Logistics Agency is completing, at their supply center in Richmond, Virginia, a quarter of a million dollar repackaging facility for damaged hazardous materials. In addition, DLA is budgeting 8.5 million dollars for construction of two hazardous material storage warehouses and several pesticide facilities.

Because I am responsible for Defense's safety and occupational health program, I am keenly aware of the problems associated with the use of chemicals in the workplace. Regrettably, many DoD employees who work with toxic and hazardous materials are generally unaware of their hazards. Each DoD manager must obtain the necessary toxicological and safety information, must digest that information, and must pass that information in a readily understandable form to each involved worker.

Full DoD component implementation of DoD Instruction 6050.5, "Hazardous Material Information System," of January, 1978, will ensure that DoD personnel are apprised of the hazards of materials encountered in DoD workplaces. I urge DoD managers to ensure that material safety data sheets are obtained for those hazardous materials used on your installations and disseminated in accordance with the DoD instruction.

I would like to close by discussing disposal. This is a pervasive problem which is not unique to DoD. A recent national wildlife federation survey of state toxic substances control programs concluded that there is "Little to prevent toxic substance disasters such as the Love Canal or the Valley of the Drums from occurring again almost anywhere in the U.S." I believe, however, that DoD policies and practices are now quite clear to prevent future improper disposal actions.

It is possible, unfortunately, for future health hazards to surface on DoD installations as a result of past inappropriate disposal. For example, right here at Charleston Naval Base, only a few hundred yards away from where I am standing, is a closed, covered landfill which contains unknown quantities of various industrial wastes. An inventory of buried waste is not always feasible, but environmental monitoring to determine chemical migration is possible and necessary.

Tomorrow, Colonel Jones, Commander of the Army Toxic and Hazardous Materials Agency will describe his agency's initiatives to characterize and evaluate such abandoned dump sites.

Chemical waste and disposalproblems arise on DoD installations due to:

- Obsolescence from age or function,
- Container deterioration,
- By-products from manufacturing processes,
- Contamination, and
- Oversupply

Thus, good management practices, for example, rotating stocks, recycling, improved ordering, and good storage, can eliminate much chemical waste. When disposal is necessary, all disposal options must be carefully evaluated and safety and environmental impacts assessed.

The Defense Logistics Agency just completed the disposal of 700 tons of various contaminated pesticides in what I consider to be an exemplary fashion. All options and impacts were carefully evaluated. The disposal action, which involved both resale and burial in an approved site, was executed without criticism or adverse environmental impact. Later in the program, you will hear about other Defense Logistics Agency's disposal initiatives.

In summary, toxic chemicals and hazardous materials are an integral, vital, part of DoD's activities. Those materials can, however, be used safely and in an environmentally sound and cost effective manner.

Your efforts to implement fully DoD Instruction 6050.5 will help to develop procedures to prevent mishaps in transportation, storage, use, and disposal.

I believe we can improve our storage and handling facilities and can ensure that our monitoring programs are adequate to assess whether our use and disposal of toxic chemicals is impacting unfavorably upon the environment. This is a large effort, however, which must start with your active participation and leadership.

I want to thank you for this opportunity to speak at this important conference. I know that the experts assembled here will provide invaluable information to us all, so that DoD may assume a leadership role in the safe use of toxic and hazardous materials. I would be glad to try to answer any questions.

(1)

HE IMPACT OF
CRA ON THE
EPARTMENT
F DEFENSE

Mr. Steffen W. Plehn
Deputy Assistant Administrator
of Solid Waste. US Environmental Protection Agency

(2)

Section 6001

Each federal agency shall be subject to all federal state and local requirements (including requirements for permits and reporting and provisions for injunctive relief and sanctions) respecting control of solid waste or hazardous waste disposal...

(3)

OCUS:

azardous Waste Management
(Subtitle C)

olid Waste Management
(Subtitle D)

ederal Procurement
(Section 6002)

(4)

HW REGULATIONS - SUBTITLE C

1. Identification/listing criteria
2. Generator requirements
3. Transporter requirements
4. Facility standards
5. Permits
6. State authorization
10. Notification

(5)

UBTITLE C HW IMPLEMENTATION

Notification: 90 days after promulgation

Permit: A - 180 days after promulgation
B - when requested, 6 mo. notice

(6)

SUBTITLE C HW IMPLEMENTATION

*Interim Status

For operating facilities which - notify and submit Part A.
Can then operate without permit.
Must meet interim status standards

(7)

UBTITLE C HW IMPLEMENTATION

Manifest System

State Programs

- Interim authorization - 2 yrs. - substantial equivalence
- Full authorization equivalent to Federal program

Direct Federal Enforcement

(8)

SUBTITLE D SW MANAGEMENT

4002: Guidelines for State Programs

- Close or upgrade open dumps
- Prohibit new dumps
- Encourage resource recovery

SUBTITLE D SW MANAGEMENT (9) 4004: Disposal Criteria- Federal standard for land disposal Defines "open dump"	SUBTITLE D SW MANAGEMENT (10) 4005: Open Dump Inventory (B) o Conducted by states o Published by EPA o Time phased over several years
SUBTITLE D SW MANAGEMENT (11) 4005: Open Dumping Prohibited (C) -Except o Compliance schedule o State plan approved	SECTION 6002 FEDERAL PROCUREMENT (12) *The Law o Highest practicable % recovered materials - 2 years o Review specifications to eliminate bias - 18 months
SECTION 6002 FEDERAL PROCUREMENT (13) *EPA Guidelines o Availability & sources o Potential uses o Vendor certification % recovered	SECTION 6002 FEDERAL PROCUREMENT (14) *Proposed Amendments o Change specification only after guidelines are issued o Statutory deadlines to follow guidelines o Goal - Relieve burdensome and unreasonable requirements
SECTION 6002 FEDERAL PROCUREMENT (15) *Guidelines under development o Fly ash use in concrete (2-80) o Composted sewage sludge as soil conditioner (2-80) o Recycled paper (6-80) o Construction products (81)	CONCLUSION (16) *Major New Federal Program *Critical Environmental Area *Large Impact on DOD

THE IMPACT ON DOD OF THE TOXIC SUBSTANCES CONTROL ACT

Dr. Kenneth C. Back, Chief
Toxicology Branch
Air Force Aerospace Medical Research Laboratory
Wright-Patterson AFB, Ohio 45433

There are a number of driving factors which markedly affect the utilization and acquisition of new chemicals within the Department of Defense, and for that matter, throughout the national industrial community. The development of fundamental information on the toxic hazards of DOD used chemicals and the need for understanding the mechanisms of toxic activity in order to establish realistic exposure criteria are increasing exponentially. The driving forces provoking increased emphasis on chemical hazard assessments include the National Environmental Policy Act of 1969, the Clean Air and Water Act of 1970, The Occupational Safety and Health Act of 1970 and the most recent Toxic Substances Control Act of 1976. The latter is one of the most definitive pieces of legislation to date and mandates a complete series of test standards designed to identify chemical hazards from the cradle to the grave and establishing minimum evaluation tests for acute, subacute, subchronic toxicity, mutagenic effects, teratogenic effects, reproductive effects and metabolic effects as well as effects on flora and fauna. Figure 1 is a much condensed version of the myriad of tests necessary for obtaining information for "premanufacturing notification" to EPA before a new chemical or an old chemical to be used in a new way may be manufactured. The vast number of tests required together with the possible use characteristics and the physical-chemical properties of the compound represents a large number of manhours and a cost of over $1.5 million. This amount of resources is to be borne by the manufacturer and it makes relatively little difference concerning the total amount of chemical to be used. Obviously, something must be done about anticipated tonnage since at the moment manufacturers of some food additives are required to produce the same data, as one planning to market multiton quantities. As a matter of fact in the fragrance and flavoring industry the total output of all manufactures in the world sell a quantity of product less than that needed to perform all the studies needed in the various protocols.

In order to perform all the necessary experiments to conform to the requirements, a multidisciplinary approach has been used by the USAF for the past 25 years. The pharmacologist-toxicologist obtains the toxicity parameters such as dose response curves, pharmacodynamics (effects on organ systems), pharmacokinetics (metabolism of compound as it passes through the body) and possible therapeutics for over exposure. The pathologist and biochemist look at cellular effects while the behaviorist looks at effects on performance. Analysis is made of methods for quantitation and detection in affected personnel and the environment for monitoring purposes and the effects on the ecology (flora and fauna) must be evaluated.

A schema for getting these data are outlined in Figure 2. It is obvious the data necessary to produce good industrial medicine standards and criteria for safe handling take 5-7 years as a minimum. Depending upon use, the cost could escalate to $10 million for cradle to grave operation.

Besides cost and the long time it takes to get the data, two disturbing points must be kept in mind. The first involves the strong stand taken by TSCA to establish standards by a process called "generic toxicology." This implies that close chemical cogeners possess the same biological properties and may be lumped for standard setting. This speeds up the process of setting standards but is completely illogical. For instance ethyl alcohol and methyl alcohol are only one carbon apart. But only methyl alcohol metabolizes to formaldehyde in the body to produce toxicity while ethyl alcohol when ingested goes to CO_2 and H_2O.

The second disturbing philosophy expounded by the EPA is that there is no dose response curve for an oncogen (tumor producing compound) and therefore one can't set a standard of exposure for such a compound. This philosophy has no scientific basis in fact. Most toxicologists have shown good dose response relationships for oncogens using laboratory animal models. It is my contention that these models can be used to provide finite standards for man and that the concept of using "lowest detectable amount" as a criterion is costly and wasteful. This is the dilemma facing the nation today when one observes the problems associated with the oncogenic (in animals) compounds such as saccharin, benzene, n-nitrosodimethylamine, chloroform, JP-4 jet fuel (contains benzene), coke oven emissions, etc.

A case in point and directly affecting the DOD is shown in the next six viewgraphs. These compare the toxicity and oncogenic potential of JP4 jet fuel and two ram jet compounds RJ-4 and RJ-5. One sees that JP4 fuel has a relatively low order of acute and chronic toxicity and that animals can accommodate up to 5 mg/L which contains 25 ppm benzene. Since there were some weight losses noted at that level, we have suggested that for an 8 hr work day, 5 day work week, 30 year working life (Threshold Limit Value, TLV) one could be exposed to 2.5 mg/L. Note that this amount contains 12 ppm benzene (Figures 3 and 4). Note also in Figure 5 that there were no increases in tumor production between controls and benzene or JP-4 regardless of dose. However, it must also be kept in mind that the TLV for benzene is 10 ppm at gas stations and 1 ppm in rubber factories. So we are saying that 2.5 mg/L JP-4 is safe. OSHA or EPA probably do not agree, although I can't reconcile a limit of 10 ppm in the gasoline area where there is a potential for 400,000 exposures while in the rubber industry the potential is only 150,000 but the limit is 1 ppm. It would appear to me that if one were really worried about the leukemogenic effect of benzene at these low levels that the TLV's would be the same.

The comparative toxicity of the ram jet fuels RJ-4 and RJ-5 are found in Figures 6 and 7. As shown, the compounds are extremely odiferous but not very toxic even at saturation. In the mutagenic potential tests, both show little potential for mutagenic effects. This is an important finding since TSCA rules imply that if any two microbial tests are positive, that one can expect the compound to be a tumor producer. There are many who claim that the Ames test and other mutagenic tests are predictive of tumor producing potential. Many of us in toxicology are not impressed with this notion, and more recent data imply that the potential for such predictions are tenuous, to say the least. Many false positives and negatives are showing up as such testing proceeds. In this instance the tests were negative, however, Figure 8 shows that RJ-5 produced more tumors than either control or RJ-4. Though the numbers of animals are small, these data red flagged the possibility that RJ-5 may be a weak tumor producer. We are in the process of repeating this work with more animals to get statistical validity.

The point is that though the two compounds are close cogeners chemically, they both produce effects at vastly different dose levels, and their oncogenic potential may also be completely different; so much for generic toxicology and for the possibility that short term testing for mutagenic effects is predictive of oncogenic potential. From a scientific management view, neither alone may be trusted completely to give the total answer and use of the short term test did not save time or money. There is no short cut for such work.

Of importance to the USAF is the fact that if RJ-4 or RJ-5 were now modified by opening one carbon-to-carbon bond or adding a methyl group, the process would have to be done all over. This is the point that must be driven home for propulsion engineers and managers. Small changes in chemistry can make vast differences in biological activity and the gathering of such data takes a long time and is extremely costly. Biological lead time is far greater than that necessary for chemical development. Since most chemical companies are reluctant to spend great sums of money for toxicology of a developing compound which may have only small military use, it is obvious the DOD must foot the bill if progress is to be made.

HEALTH EFFECTS TESTS

BASE SET STUDIES (STANDARD TESTS)

ACUTE:

- Lethality (LC-50, LD-50)
- Primary Eye Irritation
- Primary Dermal Irritation
- Dermal Sensitization

SUBCHRONIC:

- 90 Day Toxicity

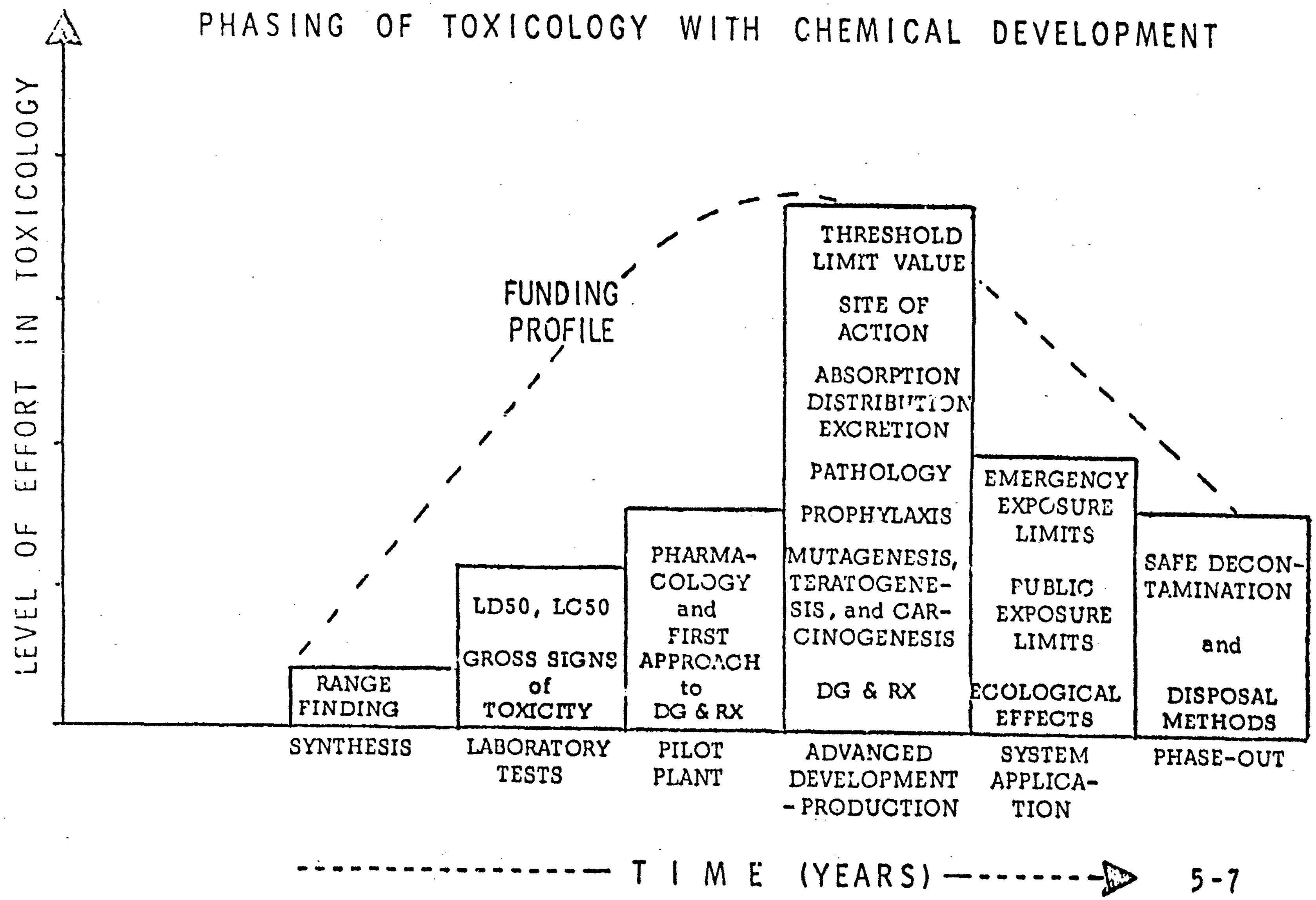
Mutagenic and Short Term Predictive Oncogenic

- Gene Mutation (3 Tests)
  - Bacteria (Ames)
  - Insects
  - Mammalian Cell Lines
  - Mouse Specific Locus
- Chromosomal Aberration (1 Test)
  - In vivo Cytogenic Damage
  - Insect-Heritable Damage
  - Rodent Heritable Translocation
- Primary DNA Damage (2 Tests)
  - Bacterial DNA Repair
  - Unscheduled DNA Repair Synthesis in Mammalian
  - Mitotic Recombination/Gene Conversion
  - Sister-Chromatid Exchange

REPRODUCTION FUNCTION:

- 1 Mammalian Species
- 1 Generation $F_0 \rightarrow F_1$
- 3 Dose Levels
- 30 Animals Per Dose Level

PHASING OF TOXICOLOGY WITH CHEMICAL DEVELOPMENT



JP-4 FUEL

ACUTE TOXICITY

ORAL	RAT	LD LOWEST	> 8,000 MG/KG
	MOUSE	LD LOWEST	≈ 500 MG/KG
6 HR INHALATION	RAT	LC LOWEST	> 38 MG/L

EFFECTS

- EYE IRRITATION - POSITIVE
- SKIN IRRITATION - POSITIVE

CHRONIC TOXICITY

EXPOSURE TIME = 6-8 MONTHS, 6 HR/DA, 5 DA/WK

EXPOSURE CONCENTRATIONS:

JP-4 - 5.0 MG/L (CONTAINS 25 PPM BENZENE)

JP-4 - 2.5 MG/L (CONTAINS 12.5 PPM BENZENE)

BENZENE - 25 PPM

ANIMALS/EXPOSURE:

6 DOGS, 4 MONKEYS, 50 RATS, 40 MICE

JP-4 FUEL (CONTINUED)

EFFECTS

JP-4:
- CENTRAL NERVOUS SYSTEM DEPRESSION, LETHARGY, EMESIS
- ↑ RED BLOOD CELL FRAGILITY IN FEMALE DOGS AT HIGH DOSE
- ↑ INCIDENCE CHRONIC BRONCHITIS IN RATS

BENZENE · CNS DEPRESSION, LETHARGY

JP-4 AND BENZENE · ONCOGENIC RESPONSE NOT REMARKABLE

MUTAGENIC POTENTIAL

MICROBIAL ASSAY (AMES) - NEGATIVE

MOUSE LYMPHOMA - NEGATIVE

UNSCHEDULED DNA SYNTHESIS - NON-SPECIFIC DAMAGE

DOMINANT LETHAL - PREIMPLANTATION LOSS (TOXIC)

SUMMARY: NO EFFECT ON FERTILITY
MINIMAL GENETIC TOXICITY
NEGATIVE FOR MUTAGENIC POTENTIAL

SUGGESTED STANDARD

JP-4 = 2.5 MG/L TLV

REFERENCES

AMRL-TR-74-78, AMRL-TR-76-57, AND AMRL-TR-78-24, WRIGHT-PATTERSON AFB, OHIO

TUMOR INCIDENCE IN ANIMALS EXPOSED TO JP-4 OR BENZENE
FOR SIX MONTHS AND HELD ONE YEAR POSTEXPOSURE

	CONTROLS	25 PPM BENZENE	5.0 MG/L JP-4	2.5 MG/L JP-4
MOUSE TUMORS				
ALVEOLARGENIC ADENOMA	3/19	6/17	4/16	7/21
LYMPHOSARCOMA	0/19	1/17	1/16	2/21
MAMMARY CARCINOMA	0/19	1/17	0/16	0/21
HEPATOMA	1/19	0/17	0/16	0/21
HEMATOPOIETIC TUMORS	6/19	1/17	4/16	3/21
THYROID CARCINOMA	0/19	0/17	1/16	0/21
TOTAL	10/19	9/17	10/16	12/21
RAT TUMORS				
MAMMARY	0/15	0/16	1/20	0/18
THYROID ADENOMA	0/15	1/16	0/20	0/18
PANCREATIC ISLET CELL ADENOMA	0/15	1/16	0/20	0/18
TOTAL	0/15	2/16	1/20	0/18

REFERENCE: AMRL-TR-76-57, WRIGHT-PATTERSON AFB, OHIO

ACUTE TOXICITY

ORAL	MOUSE	LD Lo = 250 MG/KG
	RAT	LD 50 > 16 G/KG
INTRAPERITONEAL	RAT	LD 50 = 3.2 (2.5 - 4.2) G/KG
4 HR INHALATION	RAT	LC Lo = 3200 MG/M^3

EFFECTS

HIGHLY OBJECTIONABLE ODOR
RESPIRATORY TRACT IRRITATION
EYE AND SKIN IRRITATION STUDIES IN RABBITS - NEGATIVE

RJ-5 (SHELLDYNE H)

ACUTE TOXICITY

ORAL	RAT	LD 50 > 16 G/KG
INTRAPERITONEAL	RAT	LD 50 = 3.0 (1.9 - 4.8) G/KG
4 HR INHALATION	RAT	LC Lo > 1969 MG/M^3

EFFECTS

HIGHLY OBJECTIONABLE ODOR
RESPIRATORY TRACT IRRITATION
EYE AND SKIN IRRITATION STUDIES IN RABBITS - NEGATIVE

REFERENCES

BURDETTE, G.W., JENKINS, L.J., WILLIAMS, F.W.: AIRBREATHER FUELS (STATUS RPT), CHINA LAKE, CA., NAV. WPS. CTR., 1974
AMRL-TR-76-57, WRIGHT-PATTERSON AFB, OHIO

EXPOSURE PARAMETERS

EXPOSURE TIME = 6 MONTHS, 6 HRS/DA, 5 DA/WK
EXPOSURE CONCENTRATIONS: RJ-4 = 2 MG/L (298 PPM) NEAR SATURATION
RJ-5 = 0.15 MG/L (20 PPM) NEAR SATURATION
ANIMALS/EXPOSURE: 8 DOGS, 4 MONKEYS, 50 RATS, 40 MICE

EFFECTS

RJ-4 AND RJ-5
- RESPIRATORY IRRITATION - MONKEYS, DOGS, RATS
- ↑ INCIDENCE BRONCHITIS AND BRONCHOPNEUMONIA IN DOGS AND RATS

RJ-4
- WEIGHT DEPRESSION IN DOGS AND RATS
- KIDNEY AND LIVER HYPERPLASIA IN RATS

RJ-5
- WEIGHT DEPRESSION IN DOGS

ONCOGENIC POTENTIAL

NOT CLEAR-CUT

IF ONCOGENIC - LOW POTENCY

MUTAGENIC POTENTIAL - RJ-5 AND RJ-4

MICROBIAL ASSAY (AMES) - NEGATIVE
MOUSE LYMPHOMA TEST - NEGATIVE
UNSCHEDULED DNA SYNTHESIS - POSITIVE (RISK MINIMAL)
DOMINANT LETHAL TEST (MOUSE AND RAT) - NEGATIVE

REFERENCES

AMRL-TR-76-57, AMRL-TR-78-23, AND AMRL-TR-78-45, WRIGHT-PATTERSON AFB, OHIO

FOR SIX MONTHS AND HELD ONE YEAR POSTEXPOSURE

	CONTROL	RJ-4	RJ-5
TUMORS IN MICE DYING DURING POSTEXPOSURE PERIOD			
SARCOMA	2/5	3/6	4/6
ALVEOLARGENIC CARCINOMA	1/5	0/6	0/6
OTHER	0/5	1/6	0/6
TUMORS IN ALL MICE			
LYMPHOSARCOMA	0/17	0/18	2/20
ALVEOLARGENIC CARCINOMA	1/17	0/18	5/20
ALVEOLARGENIC ADENOMA	0/17	2/18	0/20
BRONCHOGENIC CARCINOMA	0/17	0/18	1/20
HEMATOPOIETIC SARCOMA	2/17	2/18	3/20
MYELOSARCOMA	1/17	1/18	1/20
TOTAL	4/17	5/18	12/20

REFERENCES: AMRL-TR-76-57, WRIGHT-PATTERSON AFB, OHIO

SYSTEMS SAFETY APPROACH
TO THE REQUIREMENTS OF RCRA AND TSCA

by

Dr. Alvin F. Meyer, Jr., P.E., USAF (Ret.)

I am delighted to participate in this symposium on environmental research sponsored by the American Defense Preparedness Association, and to discuss two fairly new pieces of legislation causing concern among environmentalists, engineers, chemists, and, of course, the military, among others. These new pieces of legislation are, of course, the Resource Conservation and Recovery Act and the Toxic Substances Control Act.

As I am sure all of you know, RCRA requires that hazardous materials be identified and disposed of in a safe manner. It is no longer acceptable to dump unidentified, unmarked substances somewhere and let the next generation worry about the problem. RCRA will be implemented by the Environmental Protection Agency and each state is required to develop its own plan for implementation of RCRA. If they do not, EPA will develop one for them. Of course military installations are required to comply. Either DOD will set up rules for its own on-site disposal procedures and have those rules approved by EPA or it must comply with those rules developed by the state in which the military installation is located.

TSCA requires preliminary premarket testing of substances and the filing of a report on those toxicological tests with the EPA. The EPA must give approval prior to use. It is the hope of the proponents of TSCA that all the potential adverse impacts of that substance on the worker and on the environment--from production all the way to ultimate consumption--be determined and assessed. Of course, TSCA applies not only to new chemicals and substances, but also to new formulations containing recognized chemicals and marketing an existing chemical for a new application. So the implications are extensive.

And now the military services, which in my opinion, have always had an excellent program for system safety analysis are faced with new problems created by these laws. The problem, however, is not the specific requirements of the laws, but rather the degree of intrusion of EPA and state and local governments on the military services.

DOD published in July 1969 and revised in June 1977 the "Military Standard on System Safety Program Requirements", better known as Mil.Std.882A. The purpose of that standard was to provide "uniform requirements for developing and implementing a system safety program of sufficient comprehensiveness to identify the hazards of a system and to ensure that adequate measures are taken to eliminate or control the hazards".

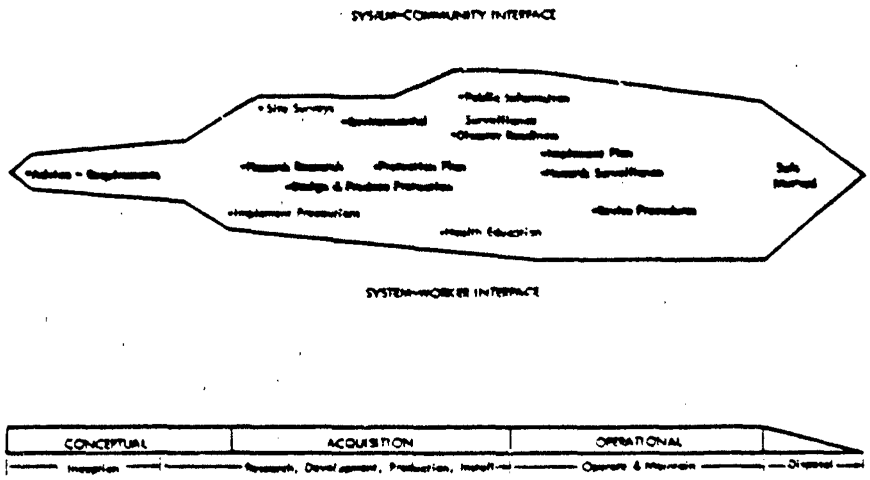
The military requires at the earliest point in time of a new concept or the use or introduction of a new material, that a Preliminary Hazards Analysis (defined in Mil. Std. 882A) be undertaken. And, although Mil. Std. 882A does not address itself to the development of research requirements, it is from the outset that unknowns should be identified. When dealing with a toxic or a hazardous material--known or suspect--a review of all the available information relating to that material must be undertaken to determine what is needed in the way of further research. This must be done concurrently with the development of the new material or process and must be made a part of the systems safety analysis.

Hand in hand with a systems safety approach containing research requirements would be a Materials Safety Data Sheet documentation system. Such a system would include information on safety precautions and safe disposal practices associated with particular substances. We all recognize, of course, that such information has to be developed on the currently available state of knowledge.

Here again the military services have long been doing just that. A paper on military applications of environmental engineering for the American Industrial Hygiene Association, written in 1959, twenty years ago, clearly shows that concern. A chart developed for that article is still valid.

The Federal approach to safety does not and cannot require a system completely free of hazards. It does require that if hazards do exist that they should be recognized and the degree of risk associated with them

SYSTEMS ANALYSIS APPROACH TO ENVIRONMENTAL & OCCUPATIONAL HEALTH



Typical considerations in systems analysis. In the analysis of the inplant-worker, and the plant-community interfaces environmental health considerations must take into account the state of knowledge as to potential hazards, as soon as possible. Based on these evaluations requirements are developed for research to be accomplished along with development of the system. Tentative health precautions and plans based on present knowledge are prepared. As results of research become available, health protection measures are finalized. Vigorous public information and worker health education measures are taken to reduce unwarranted apprehension. Once the system becomes operational, surveillance measures become routine, and protective measures are modified as experience dictates. When the system becomes obsolete, disposal of hazardous components must be in a safe manner.

Virtually every specialized phase of concern of environmental health interest is included. Following is a condensed summary, in general chronological sequence, of the scope of such activities

(1) Determination of potential hazards associated with research, development, and pilot plant operations, and establish precautions for employees and neighbors.

(2) Participation in operational site selection surveys, so as to take into account health requirements of system personnel; and also possible dangers to adjacent civilian communities.

(3) Establishment of criteria for health protection and health promotion of system operators and maintainers, and advise on design of facilities, equipment, and procedures to meet the criteria.

(4) Analyze and recommend regarding potential community environmental (air, water, land, livestock, etc.) contamination.

(5) Provide for environmental health and medical aspects of accident or disaster situations.

(6) Prepare necessary biomedical and health education documents and publications.

(7) Participate in systems test programs, to assure adequacy of criteria and health considerations tc meet same.

(8) Continually maintain required environmental medical surveillance after the system has become operational.

Taken from an article written by the author in 1959 for the American Industrial Hygiene Association.

should be identified and assessed. This is, I am sure, what we all want.

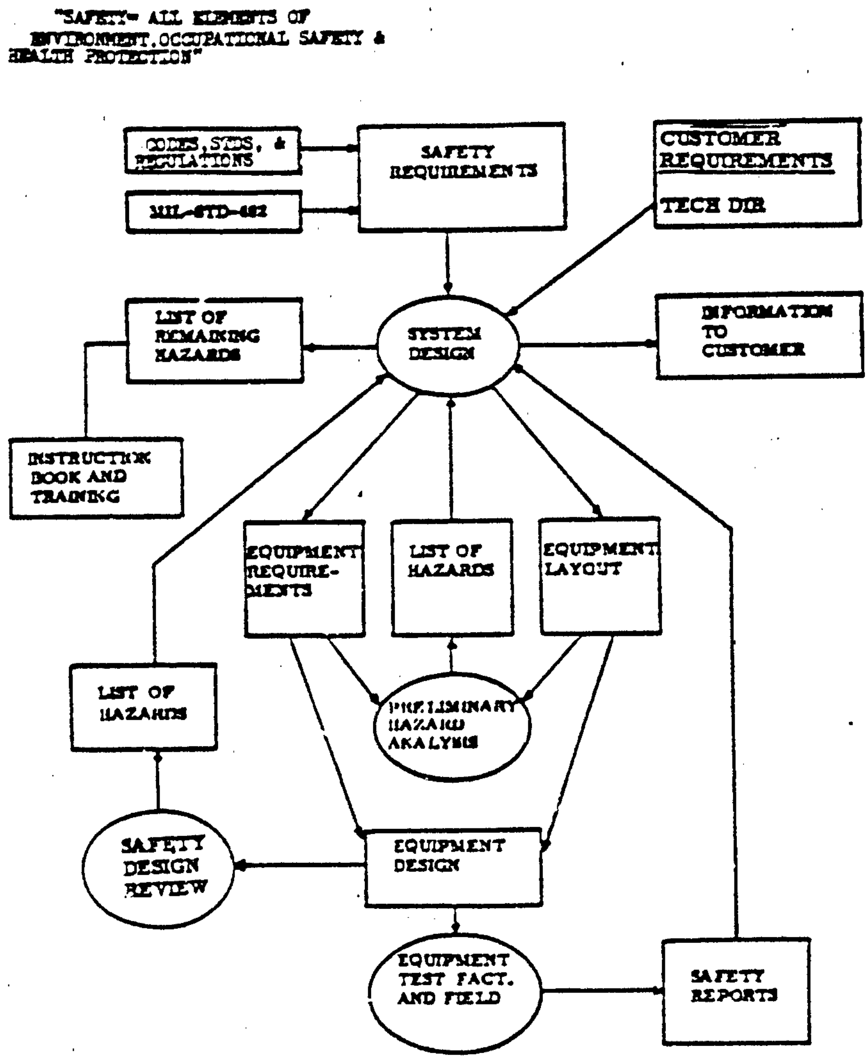
But we have to recognize that it is the very nature of military operations that may require development, manufacture, use and, quite frequently, the disposal of toxic or hazardous materials. Not all of these are related to munitions. Some are related to such things as fire extinguishants and missile propellants.

I am sure we can all cite specific cases where the failure to look to the ultimate end caused horrendous problems. Clearly herbacide orange is a real case in point. The Air Force ended up with tons of this defoliating agent developed for use in Viet Nam because nobody ever thought how to dispose of it should any be left. There were problems in our missile propellant program. I particularly remember nitrogen tetraoxide and the problems associated with developing and handling it and testing it near cities such as Denver and Los Angeles.

In sum, there are many instances where the Defense Department has in effect done all the things that these new laws require. In other instances, the requirements haven't been addressed at all. There are many instances of reasonably good compliance long before the laws were enacted and there are other cases where a systematic approach apparently was not perceived as being applicable. But it is applicable and most people associated with military production really understand the life cycle approach to systems safety engineering.

I don't mean to imply by my remarks that the Mil. Std. 882A answers all the problems now faced by the passage of RCRA and TSCA. Mil.Std. 882A has its shortcomings: It does not address itself directly to the environment and toxic substances; it merely alludes to them, although the implementing Dept. of Army document PBM-OSM-385-1 clearly alludes to "environmental damage". It also does not address itself to the end item--disposal. Perhaps the Mil.Std. needs changing or another Std. covering these new aspects ought to be developed. But I do believe the Military has led the way as far as the development of a systems safety engineering approach is concerned and expansion of its current, sound programs can readily solve most of the new problems being posed by RCRA and TSCA.

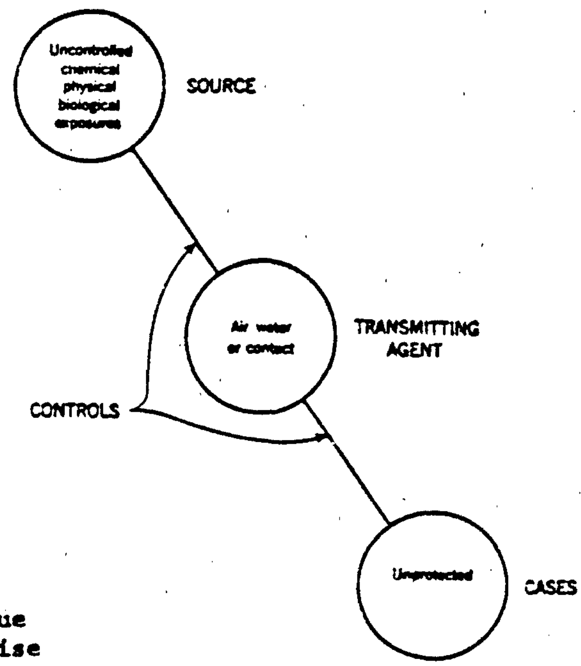
SUPPLEMENTAL DATA



Closed-Loop Safety Program

SUPPLEMENTAL DATA

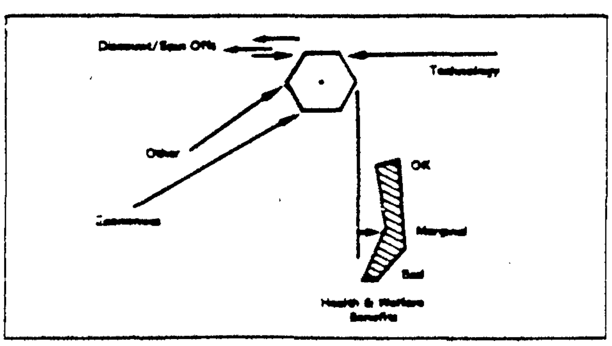
<u>ABOUT OUR BASIC CONCEPTS</u>



AFMA, Inc., provides its clients with an in-depth understanding of the relationships here shown and the principles of efficient and economical abatement of harm to individuals and populations.

The most efficient control depends on the nature and magnitude of the offending source or sources; its pathways and interactions along those pathways; and the nature, size, and distribution of the exposed population. This is true for such diverse problems as noise and airport compatible land use, worker exposure to toxic chemicals, water pollution from industrial effluents, and effects of air pollution on crops.

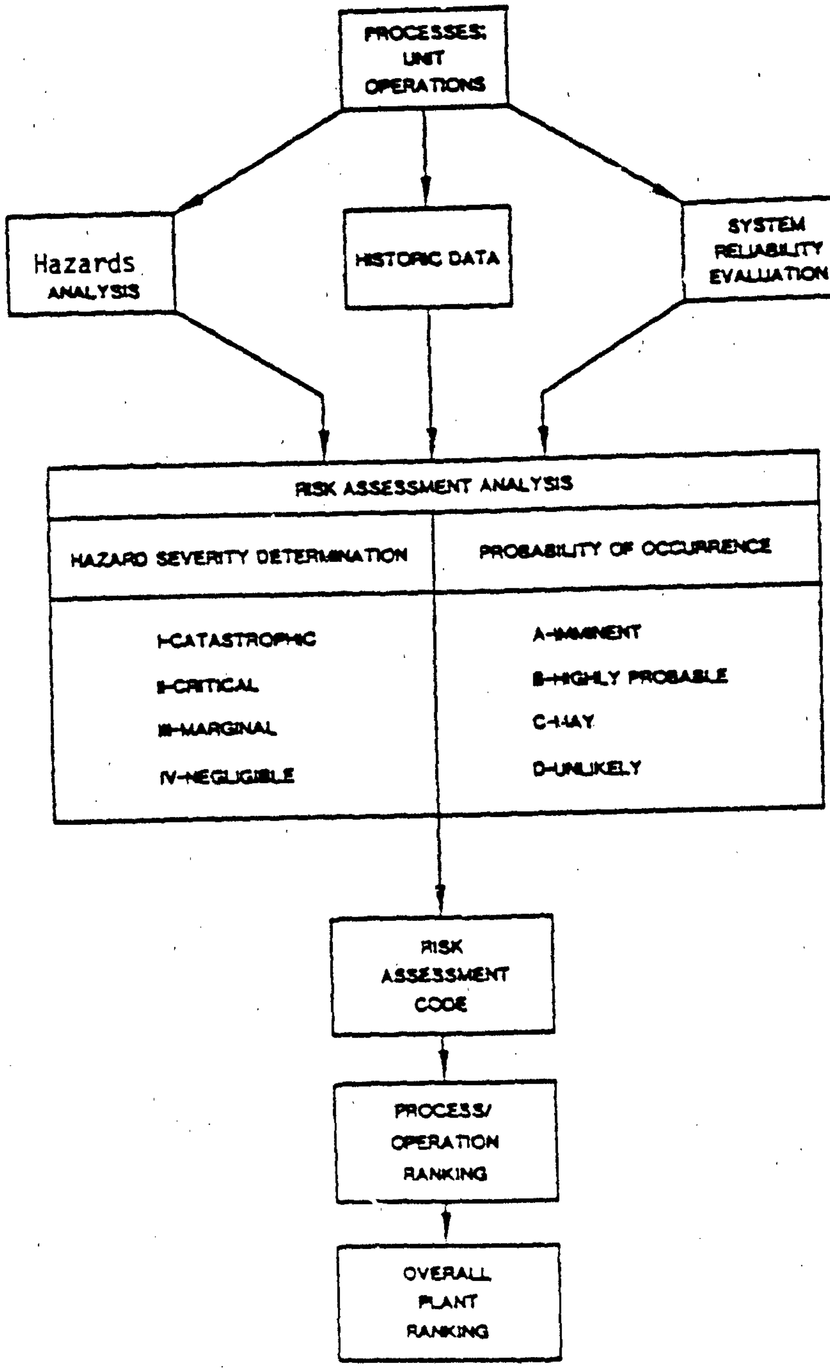
Control measures alternatives include means other than abatement works and installations in many cases. Among these are substitution of less hazardous materials or processes, systems engineering analysis to minimized emission of generation of hazard, and personal protective devices (in certain specialized industrial situations)and other applications.



AFMA, Inc.'s concept of service provides for analysis of alternatives of technology, and consideration of costs, economic, and legal implications. We offer to clients a systematic multidiscipline capability, appropriate to a specific situation, even if small in size, or to an industry or large size geographical extent.

LOGIC DECISION CHART

FOR RISK ASSESSMENT & PRIORITY RANKING



DoD Hazardous Materials Information System

Presented by: David A. Appler

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Synopsis of the presentation: The DoD Hazardous Materials Information System (HMIS) was established to provide the Defense Department with an effective means to contrally collect, assumilate the information provided to us by our contractors/suppliers in the form of Material Safety Data Sheets (MSDS). Our other objective was to develop an effective means to distribute this same data down to the installation level so that our health and safety personnel can implement procedures at the local level for the hazardous materials on the installation.

Mr. Marienthal, the Deputy Assistant Secretary of Defense for Energy, Environment and Safety approved the concept and assigned DLA the responsibility to develop and operate the system in 1977. The initial system was implemented in March 1979. Our purpose and scope for the system is to collect, centrally store, and disseminate reference data on hazardous materials. The information we are collecting is that data we need in the DoD to comply with all of the regulations we must comply within the area of hazardous materials. That range of regulatory requirements causes the definition of what is a hazardous material to vary. There are three basic areas that provide us the scope of items we are concerned with.

What is a hazardous material? In terms of our need to comply with a variety of Federal regulations, we operate under an umbrella of definitions.

Unfortunately from a regulatory standpoint there is not a single acceptable definition. But, in our management practices we must comply with all definitions or pay some significiant penalties. Our system was established to meet three basic definitions of a hazardous material, one for personal safety, one for transportation, and one for the environmental considerations involved with disposal.

Some of the concerns with personal hazards include flammability; explosions; acid burns; toxicity; radioactivity; strong irritation or other effects from smoke, fumes, dust, etc; and the potential for injury due to improper use or storage. The various shipping regulations such as DOT's CFR Title 49; and those issued by the International Maritime Consultative Organization (IMCO), the International Air Transport Association (IATA), the CAB, the UN, etc., defines our scope of hazardous items regulated for transport, and the various environmental laws such as the Resource and Conservation Act of 1976 and the Toxic Substances Control Act and others govern our scope of hazardous items as it relates to the environmentally - acceptable disposal of hazardous material.

Now, for a description of the system. The procuring activity within the Services and Agencies obtain a Material Safety Data Sheet (MSDS) from the contractor as part of the procurement contract. To assist in this an ASPR/DAR clause was developed which requires the submission of the MSDS and cites Federal Standard 313A, which gives instructions on how to complete it. The procuring activity forwards the forms to their respective Service/Agency focal point.

The focal point technically reviews the MSDS and corrects obvious errors and adds missing data when possible. Although the focal point reviews the data for technical accuracy, we do not verify the data to the extent of laboratory verification. The focal point does contact the contractor when clarification is required. Also, the focal point prepares the Transportation Data Sheet for each hazardous item regulated for shipping. The data for the Transportation Data Sheet is developed by primarily utilizing the Material Safety Data Sheet and the appropriate shipping regulations.

The focal points submit the MSDS and transportation data together or separately to the data bank at the Defense General Supply Center (DGSC) in Richmond, Virginia. All data is received in hard copy at DGSC and they do all the data entry.

In terms of what data elements we have in the system, they are listed below:

SUPPLEMENTAL DATA ELEMENTS: NSN/Local Stock Number, FSCM, Part Number/ Trade Name Indicator (Single Letter Code Representing Part No), Date, Action Code, Item Name, Item Manager, Focal Point Indicator, NIOSH Code (5 Most Hazardous Components), Specification (If Applicable), Proprietary Indicator, Storage Compatibility Code, and Supplemental Data.

MSDS DATA ELEMENTS: Manufacturer's Name, Part Number/Trade Name, Hazardous Components, Percent of Each Component, Boiling Point, Vapor Pressure, Vapor Density, Soluability in Water, Specific Gravity, Percent Volatile by Volume, Evaporation Rate, Reference for Evaporation Rate, Appearance and Odor, Flash Point, Upper Elplosive Limit, Extinguishing Media, Specific Firefighting Procecures, Unusual Fire and Explosion Hazards, TLV For Composite, Effects of Overexposure, Emergency First Aid Procedures, Stability, Conditions to Avoid, Materials to Avoid, Hazardous Decomposition Products, Hazardous Polymerization, Conditions to Avoid, Steps To Be Taken If Material is Released or Spilled, Waste Disposal Method, Type of Respiratory Protection, Ventilation, Protective Gloves, Eye Protection, Other Protective Equipment, and Precautions To Be Taken In Handling/Storage

TRANSPORTATION DATA ELEMENTS: NSN/Local Stock Number, FSCM, Part Number Indicator, Part Number/Trade Name, Focal Point Indicator, Action Code, Date, Unit of Issue, Unit of Measure, Net Unit Weight, Flash Point, Net Explosive Weight, Propellant, Radioactivity, Form, Dot Shipping Name, Dot Class, Dot Label, Limited Quantity, DOT/DOD Exemption Number, Air Only Indicator, Water Shipping Name, Water Class, Water Label, UN Number, UN Class, DOT Regulated Indicator, IMCO Regulated Indicator, CAB 82 Shipping Name, CAB 82 Class, CAB 82 Label, IATA Article Number, IATA Shipping Name, IATA Class, IATA Label, AFR 71-4 Shipping Name, AFR 71-4 Class, AFR 71-4 Label, Additional Data.

The third area I want to discuss is the output products of the system. We believe that once the data enters our system it will be relatively static. Also entry of new data will be gradual.

Therefore, our primary output is a composite microfiche publications (48:1 reduction) of all the data in the system. This is produced annually with quarterly cumulative updates. Weekly hard copy updates are provided to the focal points to assist with inquiries between publication cycles. The publication is in stock number sequence so we also include a cross reference list or index in part number/trade name sequence to assist users in finding data on items.

In addition to the publications, we have designed interrogation capabilities into the system. The methods of interrogation are:

a. A search by hazardous ingredient using the NIOSH code mentioned earlier ... either with or without the focal point indicator. This is extremely helpful in finding all items with a particular ingredient such as finding everything containing benzene.

b. A search by storage compatibility code ... either with or without focal point indicator. This will be helpful in realigning storage of hazzrdous items at a particular site into a safe, homogenous storage pattern.

c. Specific stock numbers can be interrogated. This can be used to compare an activitie's composite listing of items against the data bank to find out which ones were hazardous.

d. Also we can search by hazard class. All of the interrogations provide either a list of stock numbers meeting the interrogation condition or a listing of full file data.

SYSTEMS ANALYSIS OF HAZARDOUS WASTES MANAGEMENT WITHIN THE DEPARTMENT OF DEFENSE

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INTRODUCTION

As a Summer (1979) Faculty Research Fellow with the Air Force Engineering and Services Center the author performed a system analysis of the Environmental Technical Information System (ETIS). This is a computer system developed and maintained by the Army Construction Engineering Research Laboratory and modified and used by the Air Force. Its purpose is to provide necessary verbal information, numerical data and economic impact estimates for environmental impact assessment, environmental impact statement writing, and base realignment evaluations. It is used by engineers and planners at base, command and headquarters levels on-line over commercial telephone lines in a format designed to maximize effective use by non-programmers.

One of the purposes of the system analysis was to determine the desirability of using the existing ETIS structure as a basis for future environmental computer programming. Laws and regulations relating to environmental impact and pollution abatement are becoming so numerous and complex that computer assistance is becoming essential to proper compliance with the laws. This is particularly true in a field such as hazardous waste management with its multiplicity of hazardous substances, the multiplicity and technical complexity of the modes of generation and removal of the wastes, the hazards and difficulties of storage and disposal, and the complexity of the reporting and control requirements. Based on an extension of the ETIS analysis to hazardous wastes management, it seems likely that much could be gained through the programming of hazardous wastes data and analysis procedures within the ETIS framework. However, the present system has several limitations that need to be overcome before maximum effectiveness and widespread usability can be obtained. This paper describes how a military hazardous wastes management computer system might be created and what it might include.

ASPECTS OF HAZARDOUS WASTES MANAGEMENT

There are many tasks and procedures associated with hazardous wastes management. Some are obvious, well known and in operation; others are known, but not yet used; and some have not been identified, but are under study by the services or the Environmental Protection Agency. This paper will deal with the general tasks that should be accomplished and whether they can be done by or assisted by a computer.

<u>Definition of Hazardous wastes</u> has in large part been done. There are lists of hazardous substances in various categories and some agreement about the definition of what constitutes a "waste." While a computer cannot define

the materials, it can store and display the lists and the means of recognizing, removing, storing, neutralizing, antidoting, and disposing of them.

On-site recognition and recording of quantities and locations of hazardous wastes is the next requirement. Recognition is a matter of training and awareness. People must know what to look for and be looking for hazardous wastes. At locations where hazardous wastes are regularly generated, stored or deposited standard recording, storage, removal and disposal procedures can be established. The computer can store the data related to these activities and conditions and remind workers in an understandable way of the standard data formats and operating procedures.

Control of storage, removal and disposal of hazardous wastes requires a close link between the information about existing conditions (quantities, locations, storage times, generation, etc.) and the decisions and actions necessary to prevent or correct unacceptable conditions. A computer can store such data, evaluate conditions and suggest corrective actions. The computer could, thereby, be an aid in what might be called short-run hazardous waste management. The purpose would be to maintain base conditions within the legal guidelines.

Reporting of conditions and procedures to the appropriate regulatory agencies is a requirement of the law. The computer is very efficient in data organization and report writing. It could be programmed to format the data already stored in its files in the prescribed way, to print hard copy reports or to transfer data directly to EPA files.

The forecasting of future conditions would assist bases and EPA in anticipating future problems (hazardous waste conditions outside the guidelines) so that changes in storage, removal or disposal procedures or the scale of operations could be undertaken before dangerous conditions arose. Within certain limits a computer can be programmed to estimate future conditions. The economic impacts of base realignments are forecast in one part of the ETIS. Therefore, this is a feasible and useful computer contribution.

Long run management is the process whereby the judicious consideration of present conditions, future expections, legal limitations, operating realities and future necessities leads to an implemented plan for future activities and operations that accomplishes as much of the mission as possible within the limits of law and reason. While the computer cannot do this, it can quickly display and analyze the data, forecasts, limitations and needs in ways that can be extremely useful to those who actually manage.

Therefore, hazardous wastes management is the process of providing for and carrying out the definition, on-site recognition and recording, control, reporting, forecasting, and long run management of hazardous wastes for each military facility. The computer can be a valuable aid for many of these tasks and for some it may be the only way that compliance with the law can be achieved.

HAZARDOUS WASTES MANAGEMENT WITHIN THE ETIS FRAMEWORK

ETIS is a group of programs consolidated into a single system with a single on-line access procedure, a central location, and a common use format in which the program asks the user questions, the answers to which lead to the information or analysis needed. The questions and answers are all in normal English so the user need not be a computer programmer nor even be greatly familiar with enviornmental impact statement writing. Therefore, ETIS not only provides necessary information to trained users, but it also teaches novice users many of the requirements for the environmental compliance tasks. This rapid, on-line, simple interaction is effective in displaying and comparing data for planning and control assistance. It is useful in report writing, but it does not write the report. This or a similar format would be useful for several of the hazardous waste management tasks. The consolidated, centralized structure reduces the need for learning several access and use procedures. It reduces programming and maintenance costs while making the system available and beneficial to a large number of users at different locations and command levels.

Unfortunately, the ETIS has several limitations that would reduce its effectiveness and breadth of use in a hazardous wastes management application. These limits include being operated in a non-standard, non-portable experimental configuration; a lack of hard copy report format output; and a focus on Army needs. While these limitations are understandable given the purpose and funding of its development, they could and in my opinion should be overcome so that the hazardous wastes management task could be assisted within this system.

The system is written in C language and run under the UNIX operating system on a Digital Equipment Corporation PDP 11/50 computer part of whose time is leased from the University of Illinois by the Army CERL. This is a non-standard language (FORTRAN and COBOL are the primary military languages) and a non-standard computer owned by a non-military organization. At this time the C/UNIX combination runs only on the PDP 1100 series machines, so it is a non-portable configuration. Various problems arise in such a non-standard format, but standard languages and computers are not as efficient and effective in development or operation for this task. That is the reason CERL converted from the FORTRAN/SYSTEM 2000/CDC 6400 configuration in which ETIS was originated six years ago. Conversion to a standard language is possible and Ada, the new Military Computer Family language, is a likely candidate to be the standard language because it appears to be capable of handling this task better than COBOL or FORTRAN and nearly as well as C/UNIX. A benchmark or similar analysis is planned to test this.

The lack of hard copy output can be overcome by writing this capability into ETIS. The Navy has considerable experience in writing pollution abatement reporting programs that produce hard copy output. However, these are not interactive programs. It is easier to add hard copy output to an interactive program than it is to add interaction to a batch report writing program. If the Navy's experience could be transferred to ETIS, an extremely effective, broadly usable program could be made available to all the services.

CERL has been developing ETIS for some years with a limited budget and an Army focus. The Air Force has supported the modification of some parts of ETIS and uses the Air Force version. Since all the services are subject to the same regulations, it would seem reasonable to explore the possibility of developing a single multi-service hazardous waste management program. This would provide DoD-wide consistency, save much time and money and provide the most effective program to all. There would be no duplication of effort, the activity could be properly financed and the best ideas of all the services would be brought together for all to use.

Effective interactive use and report format output capabilities already exist, but in different places, different services, and different languages. It is hoped that these capabilities can be brought together, the limitations can be overcome, and the services can collaborate to produce a maximum effectiveness/minimum cost hazardous waste management computer system. To further that end investigations are being made of the details of possible host computers, standard languages, low cost communication networks and display capabilities. Multi-service collaboration is being encouraged in the development of such a system starting with the joint conceptualization of the system's parts and details. The planning of the decisions and tasks necessary to accomplish this should also be done jointly.

In its final consolidated form ETIS would be a large computer system capable of supporting all DoD environmental impact and pollution abatement activities. To be feasible such a system should be carefully and collaboratively planned and be developed slowly step-by-step so that each part can be justified on its own merits, financed within a reasonable budget, and tested for effectiveness before the next part is put in place. Such a plan exists in preliminary form, but it was not developed collaboratively. It is hoped that both the hazardous waste management collaboration and a broad, long run environmental impact/pollution abatement collaboration can be obtained. The returns in greater effectiveness and reduced costs would be enormous.

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PROBLEMS WITH ABESTOS IN SCHOOLS

by Larry Dorsey
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[SLIDE 1] Good afternoon. My name is Larry Dorsey. I am with the Office of Chemical Control in the Environmental Protection Agency's Office of Toxic Substances. Our office at EPA has the responsibility for implementing the Toxic Substances Control Act. One problem that we have been concerned with for the past year is the hazard caused by asbestos-containing materials in schools.

[SLIDE 2] Asbestos is a generic term for a group of fibrous minerals known for their flexibility, high tensile strength, and resistance to heat. Prior to 1973, asbestos-containing materials were placed into thousands of buildings across the country. The asbestos had four major applications:

- [SLIDE 3] Because asbestos is a good insulator, it has been mixed with cement and other materials and sprayed onto ceilings.

- [SLIDE 4] It was also sprayed onto boilers, hot water pipes, and heating ducts. As a fireproofing material, it has been sprayed onto structural steel beams to protect them from buckling in the event of a fire.

  [SLIDE 5] Because of its irregular surface, asbestos-sprayed material is a good sound deadening material. It is commonly found on airport terminal ceilings, on gymnasium and cafeteria ceilings, and in other buildings for sound proofing.

  [SLIDE 6] Finally, asbestos has been mixed with plaster and other materials and trowelled on as a decorative coating.

Asbestos can no longer be sprayed into buildings to insulate, fire proof, or deaden sound. In 1973, EPA banned the use of any material containing over 1% asbestos for these purposes. And in 1977 EPA extended the ban to cover decorative uses of the material.

[SLIDE 7] But although we have halted the future use of sprayed asbestos-containing material, we have learned that past uses may be creating a health hazard in buildings. Over the years, the material can deteriorate and release asbestos fibers into the air. Deterioration of asbestos-containing material can result from a number of causes. [SLIDE 8] The age of the material is a primary factor. The older the material, the greater its tendency to loose its cohesive strength.
[SLIDE 9] A second factor that is seen in some buildings is water damage. Water from leaky roofs can damage even hard cementitious material by carrying away the binding agents in the material and eventually causing fiber release.

[SLIDE 10] When microscopic fibers are released into the air, they can be easily inhaled. Inhalation of asbestos dust has been positively linked to a number of diseases, among them:

- [SLIDE 11] Asbestosis, a chronic lung ailment which can produce shortness of breath and lung damage
- Lung cancer
- Mesothelioma, a cancer that involves the pleura, a thin membrane that separate the lungs from the chest cavity.
- Cancer of the esophagus, stomach, colon, and other organs.

[SLIDE 12] There are three measures that can be taken to reduce or eliminate exposure to hazardous asbestos in buildings.

- [SLIDE 13] The material can be encapsulated, that is, sprayed with a sealant to contain the fibers and prevent their release. [SLIDE 14] While encapsulation is advisable under certain circumstances, it is important to realize that the asbestos will still have to be ultimately dealt with when the building is demolished.

- [SLIDE 15] The material can be enclosed behind a solid barrier such as sheet rock, gypsum board, or in this case, fixed ceiling tiles. The same restriction on encapsulation applies to enclosure as well; it is only a temporary method of dealing with the problem.

- The only sure way to permanently eliminate asbestos hazards is to remove the material. [SLIDE 16] The material must be thoroughly wetted with water to which a surfactant has been added to improve absorption.
[SLIDE 17] The asbestos is scraped off the ceiling [SLIDE 18], it is placed in plastic bags [SLIDE 19], then transfered to drums and disposed of in a landfill.

[SLIDE 20] Asbestos release is a significant health hazard in some buildings. Studies have shown that the amount of fiber release from asbestos-containing materials can reach levels that are considered potentially hazardous. EPA is particularly concerned about asbestos in school buildings, for a number of reasons.

- In all asbestos-related diseases, there is a latency period--typically twenty or more years--between initial exposure and manifestation of the disease. The exposure of children to asbestos in school buildings occurs early in their life span. Because children have much of their lives ahead of them, these years can provide the long latency period necessary for disease to occur.

- Children spend many hours in school buildings for many years, and the longer a person is exposed, the greater his or her chance of developing an asbestos-related disease.

- School children are very energetic. Asbestos-containing materials can be damaged as a result of many things that active children do.

- Finally, although evidence is not conclusive, children may be more susceptible to the effects of asbestos than adults.

It was concern over this possible health hazard that prompted EPA to begin a program to provide guidance and technical assistance to State and local officials, to enable them to identify and correct asbestos hazards in schools. [SLIDE 21] Under the program, EPA has prepared guidance documents explaining how to inspect school buildings, how to take samples of suspect materials, how to have the samples analyzed for asbestos, how to evaluate potentially hazardous conditions, and how to take corrective action if needed. These guidance documents were mailed to every school district in the country in May 1979. EPA has also prepared a videotape which highlights the information given in the guidance manual. This videotape is available on a loan basis from our 10 Regional offices. EPA has held training sessions in major cities nationwide to orient State and local officials to the asbestos problem. We have placed Asbestos Coordinators in each of the Regions who are available to advise State and local officials as they begin asbestos control programs to correct hazardous conditions in their schools.

EPA believes that this technical assistance program, which relies on voluntary participation on the part of State and local school officials, has been a good first step in alerting individuals about the asbestos problem and encouraging them to do something about it. We are now engaged in the next phase of our program: developing a regulation to control asbestos hazards not only in schools, but in other buildings as well. In the interim, as this regulatory effort gets underway, EPA has been working with the Department of Health, Education, and Welfare and with the Department of Defense to set up asbestos control programs for schools on military installations. DOD has officially recognized that asbestos can be a potential problem in buildings and has sent a memo to responsible military personnel directing them to begin programs.

EPA has also been working directly with each of the Armed Forces to address asbestos in schools on military bases. To date, the Army, the Navy, and the Air Force all have programs to deal with this problem. The Army is writing a guidance manual similar to EPA's. When this project is complete, copies of the manual and a directive letter will be sent to the commanding officer of each army installation in the U.S. and overseas. The manual will give instructions on the proper techniques for inspection of school buildings, sampling, and methods for taking corrective action.

For nearly a year now we have been working with the Navy as its asbestos control program has developed. The Navy is taking an inventory of all shore installations where potential hazards may exist, and determining appropriate control measures for these installations. They have prepared a series of manuals on this topic that are being distributed by the Office of the Chief of Naval Operations.

Our office has worked with Air Force personnel to formulate an asbestos control program for schools on Air Force bases. The Air Force is currently surveying school buildings on all 120 domestic bases to determine the extent of the problem. The survey is expected to be completed by January 10, 1980. At that time, the Air Force will begin corrective action on any schools with hazardous conditions. The next stage of their program will be to examine overseas facilities and correct any problems there.

I hope this gives you a good overview of why we are concerned about the school asbestos problem and what is being done by EPA and the military to control it. We have a toll free number 800-424-9065 that is available to answer questions concerning our Asbestos School Program and to handle distribution of our guidance materials. Copies of the guidance document are available upon request. I would be happy to answer any questions you may have either now or during the panel discussion later on.

HOSPITAL WASTE DISPOSAL
BY

CPT Anthony M. Monroe
Sanitary Engineer - October 12, 1979
US ARMY Environmental Hygiene Agency

In December 1978, the United States Environmental Protection Agency (USEPA) published proposed regulations on solid waste management which includes hazardous waste. These regulations, which were published to implement the Resource Conservation and Recovery Act (RCRA) of 1976, will have a significant impact on the handling and disposal of infectious waste on medical institutions in the US.

This paper will discuss the present methods of infectious waste disposal and the impact RCRA will have on US Army medical facilities disposal of infectious waste.

First to be discussed is the definitions of infectious waste (US Army and USEPA) and pathological waste.

Army Definition: Waste originating from the diagnosis, care and treatment of a person or an animal which has been or may have been exposed to a contagious or infectious disease (i.e., dressings from wounds and surgery, needles and syringes, and tongue depressors).

USEPA Definition: It is infectious (hazardous) if it is generated in designated areas of the hospital or if it contains microorganisms, or helminths of the Communicable Disease Center's classes 2-5 etiological agents.

The benefits of the US Environmental Protection Agency definition is that it clearly defines what is infectious and noninfectious in the hospital environment. It is infectious because of its source; thus, untrained persons who are responsible for segregation and collection of the waste from these areas, does not have to make the decision as to its infectiousness.

Pathological Waste-Anatomical Parts of Humans or Animals.

At present the Army's primary method of infectious waste disposal is by incineration. However, some hospitals are allowed to use sanitary landfills for disposal if the landfill is permitted by the State in which the installation is located and if permission from that State and The US Army Surgeon General is obtained.

Incineration creates both economical and environmental problems. Adherence to the USEPA definition will result in significant increases in infectious waste and result in requirements for new and larger incinerators. The environmental problems are associated with the increasingly high percentage of plastics in infectious waste which causes excessive heat, damages the incinerator interior, and produces excessive air emissions.

One other system that does see limited use in the Army is a grinder. This is used to grind tissues from surgery and pathology areas and then flush the material into the sanitary sewer. This grinder can be designed to crush needles, syringes and sharps after they have been autoclaved. After they are crushed, they are diverted to a basket, collected and transported to the sanitary landfill.

Infectious waste in the proposed USEPA regulations, as previously stated, will be listed as a hazardous waste and must be disposed or handled as a hazardous waste. The only approved disposal methods will be incineration, autoclaving (then burial in a sanitary landfill), or burial in a hazardous waste landfill.

Incinerators as previously discussed are not economical and can be an environmental problem due to excessive air emissions.

We believe autoclaving is an environmental overkill and would be uneconomical because of double handling, cost and procurement of the required large autoclaves, in addition to liquid-tight containers since the waste will be wet.

The hazardous waste landfill is the least desirable option. The cost for disposal per ton would be unreasonable; however, the major factor is that there are so few hazardous waste landfills in the United States, that the transportation cost would be astronomical. [Example: In USEPA Region IV (Atlanta) there are two hazardous waste landfills (SC & AL); none in USEPA Region VIII or VI (Denver & Dallas).] The limited space in the existing hazardous waste landfills should be devoted to those materials which are truly hazardous.

The US Army Environmental Hygiene Agency and other agencies (public and private) throughout the United States have submitted opposition papers to the USEPA to make changes in the definition and disposal methods of infectious waste. The reasons for these changes are that infectious waste from hospitals is no more hazardous than the waste coming from every household in the United States. The hazard is in handling the waste and not in the disposal. Thus, why should hospital waste not be allowed to be disposed in sanitary landfills with the exceptions of pathological waste which should be incinerated or autoclaved and ground because of religious and aesthetic reasons or waste from patients with rare and highly infectious diseases.

The last information received from USEPA was that they were looking at these recommendations favorably.

The US Army Environmental Hygiene Agency completed a study in 1977 titled, "Medical Facility Solid Waste Management" to determine the best solid waste handling and disposal practices available and to provide guidance for implementing these practices in planned and existing US Army medical facilities. The major point made from this study was that all hospital waste should be collected in one collection system and transported to the sanitary landfill for disposal. The factors that favor this type system are the following: Eliminates decision making as to infectious or noninfectious; eliminates double collection system, thus saving time and manpower; eliminates double transportation to the sanitary landfill; eliminates the incinerator, except for pathological and highly infectious waste.

SUMMARY: The disposal method of hospital/infectious waste must be environmentally acceptable. The three methods of disposal are incineration, autoclaving and landfilling. This Agency feels that landfilling is the most economical alternative and if disposed of in a properly operated sanitary landfill will have no adverse impact on the environment.

*The opinions or assertions contained herein are the private views of the author and are not to be construed as official or as reflecting the views of the Department of the Army or the Department of Defense.

US ARMY TOXIC AND HAZARDOUS MATERIALS AGENCY (USATHAMA) INITIATIVES

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USATHAMA has, since 1975, been engaged in a program entitled "Installation Restoration" (IR) designed to assess toxic and hazardous materials contamination on Army properties and to institute corrective measures where needed. This contamination resulted from prior manufacturing, testing, storage and disposal operations at these sites. Emphasis has been placed on those installations where contaminants are migrating or have the potential for migration off Army properties above prescribed standards or limits and to installations that have been identified as excess to Army needs and are to be released for other use. Additionally, USATHAMA has been assigned the lead role within DOD for development of IR technology and standards for use by all services.

In the four years since program initiation, USATHAMA has completed the initial assessment of some 67 installations and have instituted corrective projects or expanded surveys at some 18 sites.

Contaminant assessments at candidate sites begin with a detailed search of records by a government technical team and interviews with present and past employees to assess the potential for contaminant migration. The terrain and facilities are then examined from the air and the ground. Finally, all available information is collected relating to mission operations, waste generation and disposal, and geohydrology of the area.

Should the results of this study disclose migration potential, limited investigative water and soil sampling are then performed to confirm the existence and extent of migration. If evidence indicates that more comprehensive work must be carried out, detailed studies are then performed concerning the source(s) of pollution, transport mechanisms through the aquifer or by surface routes, analytical procedures, additional standards, and laboratory bench level and pilot processes.

The following two examples are representative of some of the contamination problems we are disclosing and our approaches to solving these problems.

At one mid-west installation, the aquifer has been contaminated with chemical by-products from nerve agent manufacture by the Army and from pesticide and herbicide production by a lessee. A state cease and desist order was issued in 1975 to abate the off-post migration and identify and control contamination sources.

The primary source of the groundwater contamination is a 90-acre asphalt lined basin constructed in the late 1950's which has received all of the installation's industrial wastes. Planning actions to correct the leaching include (1) containment of the basin by emplacement of an encircling barrier anchored in the bedrock some 60 feet below the surface, and (2) evaporation of the basin liquid and subsequent filling and capping with impermeable clay.

The main contaminants are diisopropylmethylphosphonate (DIMP), a by-product of nerve agent production, and dicyclopentadiene (DCPD), an insecticide manufacturing intermediate. All toxicity work has been completed leading to the establishment of standards for these compounds along with the necessary analytical techniques to measure in the low parts per billion range. Other contaminants are also being studied.

A key action taken to abate the migrating contamination has been the installation of a pilot boundary containment/treatment system. This system consists of a 1500 foot barrier, a series of dewatering and recharge wells, and an organic treatment system.

Contamination of residual DDT from prior lessee manufacturing operations was found to be of major concern at two southern installations. Actions to abate these problems include construction of diversion ditches, installing dams and gravel bars, and collecting and storing the sediments.

An IR technology development program has also been established. Areas of current emphasis deal with environmental standards, analytical systems, decontamination technology, data management techniques, and ecology.

APPLYING BEST MANAGEMENT PRACTICES TO PLUG THE HOLES - A CASE HISTORY AT CORPUS CHRISTI ARMY DEPOT:

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One area that does not get enough attention in dealing with environmental problems is Best Management Practices (BMP). While not costing much money, it can help a discharger avoid a lot of grief. A case in point is Corpus Christi Army Depot, Texas. This is an Army Depot on a Navy installation. For a long time, the Navy industrial treatment plant was almost constantly in violation of the NPDES permit for something. Then, as a result of studies by the Army Environmental Hygiene Agency, a combination of improved operation of the IWTP and an ambitious materials management plan by the depot turned things around. The program instituted at the depot epitomizes BMP.

Corpus Christi Army Depot (CCAD) is a tenant organization on the US Naval Air Station (NAS) at Corpus Christi. The depot's primary mission is repair, overhaul, and maintenance of helicopters. The depot is under the command of the US Army Material Development and Readiness Command (DARCOM). Current depot programs include the UH-1 "Huey" series used for troop lift, medical evacuation and cargo; the AH-1G "Huey Cobra," two-man gun ship; the OH-58A "Kiowa," observation and reconnaissance; and some parts for the CH-47 "Chinook," the large troop lift, recovery ship and heavy cargo carrier.

Including outside storage area, the depot occupies nearly 130 acres (52.6 hectares) leased from the Naval Air Station. With nearly a million ft^2 (92,900 m^2) of maintenance shops in five large hangars, and with a fully automated storage and retrieval system occupying some 340,000 ft^2 (31,600 m^2), the entire depot has nearly 2 million ft^2 (185,800 m^2) of inside working space.

The basic operations at CCAD include aircraft cleaning, sheet metal fabrication, tool and die work, plexiglass fabrication, metal plating, engine testing and maintenance, bearing repair and replacement and various shop operations. Wastewater discharges from these operations go to an industrial wastewater treatment plant (IWTP), a contact stabilization biological unit operated by the Navy.

Until the late 1976 - early 1977 time frame, spills and other discharges from the depot caused numerous upsets at the IWTP and contributed to the many violations of the discharge permit for the treatment facility. Table 1 summarizes some of the problems encountered during a six-month period in 1976.

TABLE 1 - INFLUENT PROBLEMS AT THE IWTP

DATE (1976)	PROBLEM
3/2 - 3/25	High phenol in the influent
3/16	High total chromium in influent
4/7	Chromium spill 1000 hrs, influent pH fell to 4; no source located.
5/8 - 5/9	Chromium spill traced to ruptured flange at plating shop.
8/4	Acid spill, influent pH fell to 3.7
8/5	Acid spill containing chrome
8/11	Chromium spill, influent pH fell to 2.3; traced to leaking gasket in plating shop tanks.
8/16	Major chromium spill, approximately 25mg/l in some 750,000 gallons of flow.

The last of the incidents shown in Table 1 will serve to illustrate the type of problem existing at CCAD. Just as this spill occurred, a team from the US Army Environmental Hygiene Agency (AEHA) arrived at CCAD. The AEHA team, along with CCAD and NAS personnel, established that the source was the plating shop, where someone had purged a 500 gallon tank of concentrated chromic acid. Whoever purged the tank simply opened the valve, allowing the contents to spill into the sump leading to the industrial waste sewer. There were ways to manually contain such spills, but IWTP personnel were not notified. The result was a severe upset at the IWTP and permit violations for chromium and other pollutants.

The root cause of this and like problems was lack of control of discharges to the industrial sewer. Continued investigation by AEHA revealed that this was but a symptom of a larger problem, lack of materials management. An inventory of the depot showed hundreds of drums of a wide variety of paint stripping and metal surface preparation and coating compounds in open and unattended storage.

Any operator at any time could apply any chemical to any job anywhere in the depot. This was an inefficient way of doing business and occasionally resulted in damaged parts and equipment through misapplication of chemicals. Moreover, it led to many uncontrolled discharges of pollutants with little opportunity for those who were charged with treating the wastes to be able to react to the incidents of discharges and do their job properly.

On 1 September 1976, the then new Commander of CCAD and Navy personnel were briefed by the AEHA project officer. The briefing delineated corrections and improvements in the IWTP operation and the need for a strong materials management program. Such a program would not only save money and resources, it would also help in reducing the pollution problems the Army and Navy were facing.

CCAD began an intensive materials management program. The major steps taken included:

- Only authorized chemicals were procured. Review of proposed procurements by environmental, safety and quality assurance personnel became mandatory.

- Tight control of chemical inventories was instituted.

  • Each separate work center was surveyed and an approved chemical listing developed for the products they needed.

  • A requirement by a work center for a chemical not on the listing was not honored by the Supply Department.

  • If a request was denied, the work center was then required to receive a special approval from the Chemical Branch, Quality Assurance Directorate

  • The Chemical Branch was also required to perform periodic analysis of cleaning, electroplating, and process solutions, as required to insure conformity with applicable Process Standard requirements and direct shop supervisors to makeup, change, add, or dispose of laboratory controlled chemical solutions.

- No chemicals could be discharged to the industrial sewer without authorization. If disposal of any conentrated waste is required, it is either removed by a contractor whose services have been retained by CCAD or discharged to the industrial sewer in such a way as not to cause upsets and in full coordination with IWTP personnel.

- A technical liaison has been established to provide guidance to both Army and Navy personnel to assure smooth transition of wastes from the Army to the Navy.

- When process tanks are empty, detailed inspections are made to reduce the likelihood of spills due to equipment failure.

- An intense information and education program was initiated to assure that CCAD personnel know the environmental and safety ramifications of their actions.

- Should a spill occur, procedures have been established for quick notification of appropriate personnel so that available remedial measures can be taken to minimize the impact.

- Procedures for controlling chemicals and process solutions are clearly spelled out in CCAD regulation 700-16, which has been widely disseminated. Appropriate disciplinary procedures have been established for those who violate the regulation.

The results have been most encouraging. Table 2 shows some of the permit violations during the six-month period in 1976.

TABLE 2 - PERMIT VIOLATIONS

DATE (1976)	PARAMETER	PERMIT REQUIREMENT lb/day	(Kg/day)	ACTUAL CONDITION lb/day	(Kg/day)
3/2	phenol	0.81	(0.37)	10	(4.54)
3/3	phenol	0.81	(0.37)	13	(5.90)
3/5	phenol	0.81	(0.37)	20	(9.08)
3/9	phenol	0.81	(0.37)	14.1	(6.40)
3/16	phenol	0.81	(0.37)	2.8	(1.27)
March	avg Cd	0.11	(0.05)	0.21	(0.095)
March	avg phenol	0.54	(0.24)	6.0	(2.72)
March	avg Ni	1.6	(0.70)	2.8	(1.27)
4/8	Cr	27.1	(12.30)	59.5	(27.20)
April	Cd	0.11	(0.05)	1.2	(0.544)
5/4	Cd	0.11	(0.05)	1.43	(0.63)
5/11	Cd	0.11	(0.05)	1.82	(0.87)
5/18	Cd	0.11	(0.05)	1.20	(0.544)
5/26	Cd	0.11	(0.05)	1.46	(0.355)
6/9	Cd	0.11	(0.05)	1.00	(0.454)
6/15	Cd	0.11	(0.05)	0.92	(0.42)
6/22	Cd	0.11	(0.05)	1.22	(0.553)
6/28	Cd	0.11	(0.05)	0.58	(0.267)

DATE (1976)	PARAMETER	PERMIT REQUIREMENT lb/day	(Kg/day)	ACTUAL CONDITION lb/day	(Kg/day)
7/14	Cd	0.11	(0.05)	1.00	(0.454)
7/23	Cd	0.11	(0.05)	1.36	(0.617)
7/28	Cd	0.11	(0.05)	3.84	(1.78)
8/13	Cr	27.10	(12.30)	65.90	(29.90)
8/18	TSS	163.00	(74.10)	527.00	(229.00)

By early 1978, the violations had disappeared completely. NAS has been in compliance since then.

It is not always possible to attain compliance with wastewater discharge criteria through process control. However, a good materials management and process control program can go a long way toward attaining compliance. Sometimes the goal can even be reached. The CCAD story is a case in point.

ELECTROCHEMICAL WASTE TREATMENT PROCESSES: ADVANCED STATE-OF-THE-ART by John E. Nohren, Jr. and Dr. Karl Moeglich, Innova, Inc., 5170 - 126th Avenue North, Clearwater, FL 33520 (813) 577-3888

The Innova processes to be discussed are principally concerned with the treatment of water, water-borne toxins, organic and ionic, and the dewatering of slimes or sludges. To perform these tasks Innova has developed three basic processes, each of which employ as a basic mechanism, the boundary layer phenomenon or the application of surface free energy. This paper will not discuss the mechanism of the processes, but rather their potential applications. However, each process was theoretically predicted prior to the commencement of experimentation, and are based on sound scientific fundamentals.

Innova technology is based on three principal processes: the first process utilizes the Innova Ion Transfer Membrane which as the name suggests allows for ion transfer, not ion exchange. This unique membrane does not function as a diaphragm or through osmosis, but rather functions as a species separator in an electrolysis cell. Using the Innova Ion Transfer Membrane we can separate and concentrate both anions and cations, with equal efficiency and if desirable, even in cross flow. As an example, in treating electrochemical milling sludge we utilized a dialysis configuration. By dialysis we simply mean a three compartment cell with each compartment separated by the ion transfer membrane. In this instance the sludge is placed into the center compartment or dialysate. When a direct current of approximately 4 volts and 20 amps is applied, the existing metal complexes present in the sludge are disrupted with the sodium transferring to the cathode compartment containing distilled water and thus producing sodium hydroxide. At the same time, the anion NO_3 is transferred into the distilled water contained within the anolyte compartment producing nitric acid. If desired, the anolyte and catholyte can be recombined to regenerate the original electrolyte. In the dialysate compartment the metals precipitating as pure hydroxides are freed of their strong coulumbic charge and multiple layers of boundary water. This sludge when removed from the cell will readily air dry and the remaining supernatent is dischargable to the environment freed of the heavy metals. The economics of this test program indicate that 1000 gallons of sludge can be treated for $16.00 at 3¢ per kilowatt hour. Work for this particular application was performed for ARRADCOM at Picatinny Arsenal and is relevant to the problems inherent in Scranton as well as other munition plants chemical milling the various high chrome alloys.

Uniquely, the Innova membrane can function in such environments as sludge, slimes and organic wastes without fouling or plugging as would be the case with other membrane technologies.

The Innova membrane may be constructed from a wide variety of materials which are selected for their resistance characteristics to the particular environment within which they will operate. As an example, the membrane employed for the recovery and concentration of chromic acid from plating wastes is of a polyester base. This particular material provides a projected life of three to five years in 15% chromic acid concentrations. The standard chrome recovery membrane assembly is modular in nature containing independent anodes and cathodes and may be added to or removed from a system in its entirety permitting ease of maintenance as well as the ability to handle a wide range of floor requirements through the simple replication of modules. Put into perspective, one system module tank with the physical dimensions of 2' x 4' x 2' deep containing eight membrane cells, or approximately 21 square feet of membrane area, will typically remove and concentrate up to four pounds per day of chromium trioxide. The operating costs (essentially power costs only) are between 55¢ and 95¢ per pound of chromium trioxide recovered, the variation depending upon the operating conditions, using a basis of 3¢ per kilowatt hour. Additionally, as an example of the range which the technology can operate within, we have introduced 500 ppm of Cr VI into the catholyte and without difficulty removed it to below 0.01 ppm. Furthermore, we have maintained the Cr VI gradient on each side of the membrane at ten million to one.

Innova membrane technology can be applied to a wide range of applications which include the destruction and concentration of metals present in lead azide, the treatment of toxic ponds such as Basin F and Rocky Mountain Arsenal, the treatment of herbicidal wastes and agents high in sodium content, removal and concentration of radioactive wastes and a host of other applications including the simple deionization of water.

With respect to the treatment of nuclear wastes, we have run tests on a synthesized solution of Three Mile Island reactor waste with highly positive results. The synthesized solution was introduced into the dialysate chamber of a dialysis cell, resulting in the transfer of the various elements into the respective anolyte and catholyte compartments. Our early test results will not allow us to state conclusively that the supernatent would not remain somewhat radioactive, however, the radioactivity would be sufficiently reduced to permit effective treatment by evaporation or other normal means without the usual hazard to operating personnel in case of equipment malfunction or breakdown. In a somewhat similar laboratory program, we have also been successful at separating U235 from holding pond water, precipitating the uranium as uranyl hydroxide. Currently we are pursuing, under contract, three separate applications in the nuclear area.

The second principal process which Innova has developed is a single combined process which will coagulate particulate matter present in an effluent while concurrently oxidizing or reducing organics found in solution, including bateria and virus. This process is simply referred to as the Innova Coagulation/Oxidation process. With this process the oxidation is not limited to the face of the electrodes but rather occurs throughout the entire body of the circulating influent. The reaction occurs as a result of the dissociation of water into the hydrogen ion and the hydroxyl radical which is one of our more powerful oxidizing agents. This dissociation takes place as a result of corona discharge which occurs whenever highly conductive particles within the Innova fluidized bed come in close proximity with one another. Within the body of the cell, these highly fluidized bed particles act as miniature generators producing one hundred thousand volts per centimeter in a frequency of ten thousand hertz. It is the transfer of this energy which dissociates the water freeing the hydroxyl radical. Concurrently the high frequency generated will throw the coulombic charge of colloidally suspended particulate matter into momentary disarray freeing the bound water and thus permitting agglomeration of adjacent particulate matter.

The Innova Coagulation/Oxidation process is not only extremely effective and efficient, but also allows for a wide range of design latitude. An example of its capabilities has been demonstrated in the treatment of TNT pink water under a program sponsored by MERADCOM and Ft. Belvoir where we have successfully reduced the effleunt contamination from 150 ppm TNT to less than 1 ppm TNT at a treatment cost of approximately $1.90 per thousand gallons. (This cost equates with the treatment cost of approximately $8.00 per thousand gallons using carbon absorption technology which leaves a secondary disposal problem.) Additionally, gas analysis indicated the production of no noxious gases with the very minor exception of a few ppm carbon monoxide. Under the MERADCOM test program, we further tested the compatibility of the treated TNT effluent by maintaining five highly sensitive fish species within 100% treated pink water for a period of three months with no fatalities. In fact, we have not yet found a dissolved organic which could not be effectively treated, including phenol and PCB's. The versatility of our processes can be further demonstrated by combining the oxidation/coagulation system with the Innova membrane for treatment of Rocky Mountain Basin F effluent as well as the treatment or demilitarization of other chemical agents containing both metal ions and organic compounds.

Additional test programs undertaken thus far indicate that the Innova coagulation/oxidation process further offers considerable potential for the treatment of Army Field Hospital wastes as well as sanitary wastes such as sewage and laundry and shower effluent. As an example, these tests have indicated that a thousand gallons of raw sewage could be treated for approximately 10kwh. Results and economics of our laboratory programs are available upon request. (While perhaps somewhat out of context with this discussion, it should be noted that pre-treatment with the Innova Coagulator/Oxidizer substantially enhances the life capabilities of reverse osmosis treatment units being utilized for such applications as field water generation.)

The third Innova process applicable to this discussion is a means by which slimes and sludges may be electrically dewatered from a 6 to 11% starting solid concentration to any degree of concentration desired. Practically, we find that it is only necessary to dewater to the point that the coulumbic charge is broken and sufficient water removed to permit air drying or, if metal recovery is desired, that the matrix void water has been removed thus allowing for acidulation. In the phosphate industry we dewater slimes to approximately 25% which removes the void water allowing for acidulation with sulfuric acid to bring the contained elements into solution. The Innova dewatering system is essentially electrophoretic in nature however, is sufficiently improved to permit economic and efficient dewatering of slimes and sludges. An added advantage of the Innova system is its ability to separate the heavy metals from the sludge and supernatent thus permitting the discharge of the supernatent into the environment and the utilization of the sludge, in many instances as a valuable by-product for fertilization and soil conditioning.

This discussion is by necessity very general in nature, however the processes are fully patented and additional information is available upon request.

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