PRELIMINARY EVALUATION OF PETC-COAL CONVERSION SOLID AND HAZARDOUS WASTES. PROGRESS REPORT, SEPTEMBER 15, 1977--SEPTEMBER 30, 1978

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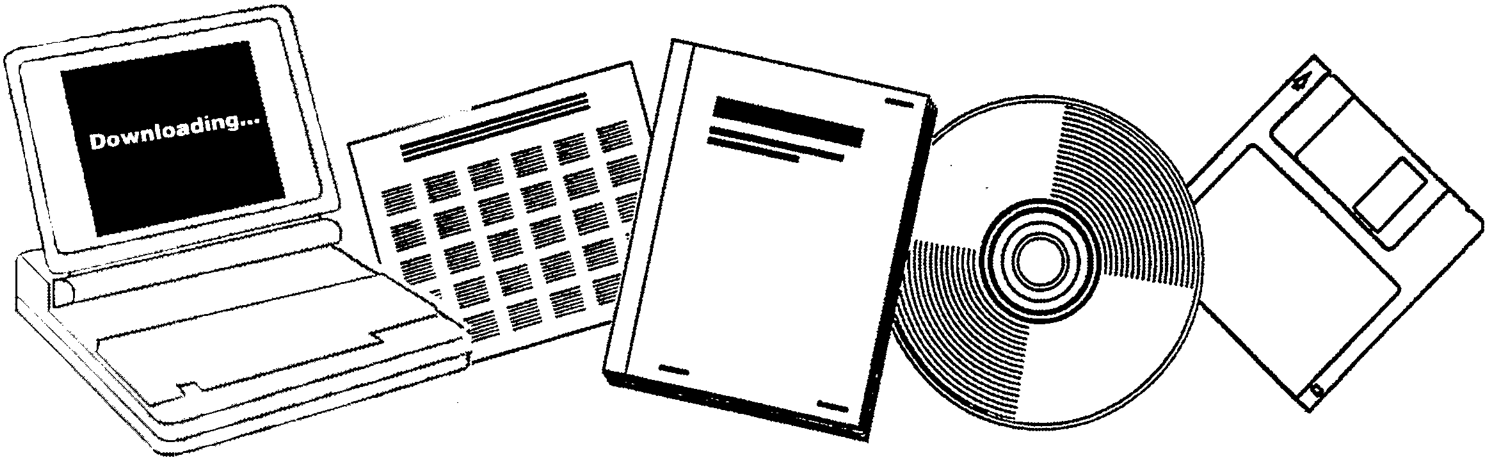

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PRELIMINARY EVALUATION OF PETC-COAL CONVERSION SOLID AND HAZARDOUS WASTES

Progress Report

For Period September 15, 1977 to September 30, 1978

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Progress to Date:

Research efforts to date have been in two major directions, a) solid and hazardous waste problems relative to PETC, and b) solid and hazardous waste problems relative to coal gasification and liquefaction conversion processes. It is intended that bench scale coal conversion processes located at PETC be considered as small but typical models for residuals sample generation. A literature search activity has begun in order to develop a data bank of coal conversion residual characterizations, and identify other centers of hazardous waste handling research expertise.

Two pre-doctoral and one masters student are supported by this project in the areas of leachate characterization, migration, and toxicity. Two unsupported students are also working on this project in areas of application of proposed "standard" leaching tests and rapid leaching tests to coal conversion residuals. Three undergraduates and two graduate students to date have used this subject area as the basis for term reports in their respective courses. It is anticipated that future work shall emphasize coal conversion residuals with the building of bench scale testing apparatus while maintaining a supportive activity for PETC hazardous wastes.

Abstract

This progress report reviews issues and local area practice relative to the disposal of small quantity laboratory solid and chemical wastes from the PETC site.

ENVIRONMENTALLY ACCEPTABLE DISPOSAL OF PETC SOLID-HAZARDOUS WASTES

This progress report results from a "Special Research Support Agreement" (SRSA) sponsored by the Environment and Conservation Division of the Pittsburgh Energy Technology Center (PETC), Department of Energy.

The overall objective of this study is to deliniate problems of environmental concern relative to the disposal of solid and chemical liquid residuals from coal conversion facilities, and from the Pittsburgh Energy Technology Center.On-going bench and pilot scale research at PETC provides this research effort an excellent opportunity to gather and conduct evaluations on potential coal conversion solid residuals.

The Pittsburgh Energy Technology Center is in the forefront of research and development in the field of synthetic and gaseous fuels from coal. As the major Federal laboratory in the area of coal conversion and utilization, PETC employes a staff of about 370 scientists, engineers, technicians, and support personnel to further its research mission. PETC research activities encompass direct and catalytic coal liquefaction, fluidized bed (SYNTHANE) and catalytic gasification, petrochemicals from synthesis gas (Fischer-Tropsch Synthesis), coal-oil slurry combustion, magnetohydrodynamic power generation, and appropriate environmental and process support research.

PETC is being considered in this study as the best available model for generators of both coal gasification and liquefaction residuals. Samples shall be gathered from appropriate coal conversion bench scale and pilot-sized facilities at PETC and other facilities for leaching, handling, and toxicity testing of the leachate. Results of these studies shall be integrated into a definitive document outlining the quantitative and qualitative problems of coal conversion solid residuals with proposed solutions.

The principal activity during this reporting period was gathering data and publications in two general areas:

a) that relative to what is known of the chemical composition of coal conversion solid residuals, and

b) that relative to general laboratory hazardous waste collection and disposal emphasizing facilities in the area neighboring the PETC site (i.e., the Pittsburgh metropolitan area).

PETC LABORATORY WASTE

In the past, solid and chemical laboratory wastes from PETC were handled in the following manner:

a) municipal landfill with contract haulage
b) unknown disposal with contract haulage
c) direct on-site land disposal
d) on-site detonation
e) thermal oxidation at the SYNTHANE plant

An earlier survey of solid wastes of generation at the PETC site indicated a wide assortment of mixed laboratory organics and inorganics, each of relatively small volume. Some materials could be considered toxic (i.e., nickel compounds, mercury compunds), and other flammable (used benzene, ethers, acetone, mixed solvents), however none could be considered as particularly chemically unstable or radioactive. Thus, the problem of hazardous waste handling and disposal from the PETC site may be best described as the proper management of small volumes of mixed hazardous wastes; a problem shared by other corporate and institutional research facilities in the local area.

Past accepted practice by PETC for hazardous waste disposal is now considered unsatisfactory due to increased awareness of the implications of storing and handling waste chemicals and an awareness of recently passed Federal legislation(1) relating to "cradle the grave" responsibility and liability for such materials.

In a separate study contracted to the University of Pittsburgh, entitled "Environmental Assessment of Pittsburgh Energy Research Center", questionnaires were prepared and sent to each analytical and process laboratory in Buildings 58, 83, and 84, of the PETC site. Activities in these laboratories comprise the bulk of process and analytical support research in the areas of coal gasification and liquefaction. An example of the responses from one such analytical laboratory is given below.

Site 1

Supplies Used: Reagent grade acids and organic solvents
Heavy metal solutions in water

Samples Processed: Waste water, Coals, Oils, Tars,
Chars, Ash

A complete listing and analysis of specific laboratory constituents is forthcoming, however, preliminary data analysis coupled with the previous 1976 survey(2) indicated, as above, a wide variety of small volume materials.

DISPOSAL FROM PETC SITE

Within the past year, PETC has partially alleviated its site specific hazardous waste disposal problem by contracting with RAD Services, Inc. This Company provides for the haulage of small volumes of hazardous wastes that fit into 55 gallon drum containers from an industrial site to a suitable burial ground.

Caution should be emphasized when entering into contracts with haulers (known as brokers in the trade) such as RAD Services. Under provisions of the Resourse Conservation and Recovery Act, PL-94-580, despite the fact that contracts between PETC and haulers provide for transfering of ownership of wastes to the hauler, and subsequently to the burial site, in fact, the contractor cannot relieve PETC of the perpetual responsibility and liability it has as a generator for ultimate disposal of its wastes.

Although enforcement criteria and operational regulations relative to this new legislation are yet to be promulgated, it is entirely conceivable that at some date in the future PETC may be required to dig up and properly re-dispose of incorrectly landfilled solid wastes. In addition, there is every reason to believe that this Federal legislation will equally apply to demonstration and commercial scale coal conversion facilities.

PROBLEMS ASSOCIATED WITH DISPOSAL OF SMALL VOLUME HAZARDOUS WASTES

While RCRA (PL-94-580) (1) is the law of the land, guidelines and criteria have not as yet been formally proposed or published in the Federal Register. Strict regulations, however, do exist in the form of Department of Transportation (DOT) Title 49 regulations, Parts 100 to 199, which control the transportation, manifest system, labeling, and packaging of hazardous wastes.

Such wastes are often repacked in special DOT specified 55 gallon drums. Thus, a knowledge of waste compatability is needed to properly re-package small volumes of laboratory waste materials for ultimate burial. The real value that a hauler, such as RAD, can provide to PETC, is the ability to package laboratory wastes in a chemically compatable fashion, a high degree of familiarity with DOT regulations, the ability to cope with the highly detailed manifest system, certification and insurance requirements of such shipments, and the ability to locate "satisfactory" hazardous waste burial sites for such materials.

As indicated above, the ultimate liability and responsibility of long term disposal of hazardous wastes lies with the generator. Accordingly, it is recommended that the PETC Administrative Division with the Environmental and Conservation Division draw up applicable criteria and take positive steps in examining ultimate disposal sites and permits used by both disposal site operators and contract haulers as they relate to the PETC site.

Description of Pertinent Legislation

In October, 1976, the "Resource and Recovery Act"(PL-94-580) was signed into law. Congress intended that RCRA address the problems of a) increasing amounts of waste being generated as a result of national economic and population growth, b) institutional and technical problems associated with urban solid waste collection and disposal, c) open dumping of solid wastes*, d) human health and environmental dangers resulting from the improper disposal of solid and hazardous wastes, e) the increasing amounts and changing character of sludges and residues as a result of the Clean Air Act, and Water Pollution Control Act, f) the wasteful burial of recoverable resources, and g) the development of solid wastes as energy sources. As a result of this legislation, solid and hazardous waste control shall in time become as institutionalized as current national air and water pollution control themes.

Subtitle C (Hazardous Waste Management) and subtitle D (State or Regional Solid Waste Plans) of the Act will probably impact the most on both PETC and future coal conversion facility solid waste handling and disposal. EPA is required to define hazardous wastes and criteria to document toxicity. In addition, EPA is required to issue standards for generators and transporters of hazardous wastes with respect to labeling, containerization, and disposal. It is not known at this time whether these latter regulations will differ substantially from existing DOT regulations.

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* It is possible that the legal definition of an "open dump" include any disposal site not in compliance with forthcoming EPA regulations.

A permit system shall be developed for treatment and disposal facilities of hazardous wastes. The management and enforcement of these provisions shall enventually lie with the states, however, the states at present appear not to have the personnel or fiscal resources necessary to handle this added burden.

Each state is required to develop quidelines for the regionalization and regional planning of solid and hazardous waste handling and disposal, and appoint an agency for the implementation of such state plans. There is every reason to believe that demonstration and commercial sized coal conversion facilities will be subject to this Federal act. Indeed, the concept of "institutionalization" of hazardous wastes will bring questions of siting and environmental acceptability of future coal conversion demonstration and commercial plants more into the public eye. The ramifications of this act should be brought to the attention of present DOE project managers.

As an example of new state activities in this area, Chapter 75, "Solid Waste Management Rules and Regulations", for the Pennsylvania Department of Environmental Resources, Revised May, 1977, outlines standards for hazardous solid waste management. A permit system for disposal facilities is mandated by Paragraph 75.31-d of the Act, much in accord with pending EPA guidelines.

Overview of National Disposal Practice

TRW, Inc., was contracted by the EPA to provide an assessment of hazardous waste practices from the organic chemical, pesticides, and explosives industries (3). Table 1 taken from that report is reproduced below. It is instructive to note that of the plant sites sampled, almost 70% of all hazardous wastes went to incineration, and about 2/3 of all such wastes (48%/69.7%) were incinerated in an "uncontrolled" manner.*

Three levels of solid waste disposal technology are defined by the TRW report. Level I represents technology and practice generally applied in industry...for hazardous wastes this is considered on-site uncontrolled incineration and landfill. Level II technology represents the environmentally "best" technology in commercial use in at least one location, while Level III technology is that deemed necessary for adequate environmental protection. Controlled on-site incineration may be considered to be both Level II and Level III technology, as determined by TRW, and thus should be evaluated for eventual application to both PETC and larger scaled coal conversion facilities.

It is acknowledged that incineration with appropriate air and water pollution controls is an energy intensive and expensive operation. The trade offs that any particular site must face is that of expending the appropriate dollar and energy resources in the present and resolving the hazardous waste problem absolutely, or expending less dollars and energy in the present but accepting a

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* "Uncontrolled" used in the context of the TRW report, (EPA Report #SW-118c) indicates incineration in the absence of appropriate air and water pollution control devices.

risk of future accidental releases of hazardous wastes to the environment by a third party land fill operator. The assessment of future risk in the hazardous waste area in an emerging art. It is this writer's opinion however, that it is wothwhile for the Federal Government to expend such dollar and energy resources to render harmless PETC hazardous wastes and thus not assume any future risk associated with their land disposal. Scale up of this concept to larger scaled coal conversion facilities has yet to be worked out.

Table 1 Hazardous Waste Treatment/Disposal Technology Distribution — Selected Organic Chemical Plant Sites

Treatment and Disposal Location/Process	Number of Hazardous Waste Streams	% of Total Number of Hazardous Waste Streams	Annual Volume Actual Tons*	Percent of Total Annual Actual Tons	Annual Volume Estimated Dry Tons*	Percent of Total Annual "Dry" Tons
On-Site						
Landfill	55	31.6	20,723	4.7	20,723	14.8
Incineration	(58)	(33.3)	(97,759)	(21.9)	(97,759)	(69.7)
Controlled	31	17.8	30,411	6.8	30,411	21.7
Uncontrolled	27	15.5	67,348	15.1	67,348	48.0
Deep Well Injection	10	5.7	282,889	63.6	2,829	2.0
Biological Treatment/Lagoon	13	7.5	24,325	5.5	243	0.2
Recovery	21	12.1	11,670	2.6	11,670	8.3
Landfarm	1	0.6	NA**	NA	NA	NA
Contractor						
Landfill	9	5.2	5,100	1.1	5,100	3.6
Incineration	7	4.0	2,100	0.5	2,100	1.5
TOTAL	174		444,566		140,424	

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*metric tons

** NA indicates Not Available

after reference(3)

INDUSTRIAL AND INSTITUTIONAL DISPOSAL OF LABORATORY WASTES IN ALLEGHENY COUNTY

A survey was performed of larger industries and institutions laboratory wastes in the local area, with regard to segregation and disposal methods. It is hoped that this information will be helpful to the Pittsburgh Energy Technology Center (and, in general, other energy technology centers and coal conversion plants) in the development of environmentally acceptable integrated schemes for the categorization, segregation, and disposal of laboratory wastes.

Company A

Company A divides its wastes into six major categories. Category (1) consists of clean combustable liquids. These liquids are put into Department of Transportation approved containers and labeled properly. Segregation is made between chlorinated and non-chlorinated liquids. The 55 gallon drums are then taken by Browning-Ferris Industries, a local hauler, to an incinerator in Warren, Ohio. In the past fifteen months one load consisting of a volume of forty drums was taken to Warren.

Category (2) wastes are the "toxic wastes", such as heavy metals like chromium, lead, copper, and zinc. These wastes are put into five gallon labelled containers, which in turn are put into 55 gallon drums for transportation purposes. This work is also performed by Browning-Ferris Industries, and is taken to a Findlay Township municipal landfill. The wastes are put into small individual cells which are separate from the daily landfill. These individual cells have a compacted clay and ash lined base. The outer containers (55 gallon drums) are not landfilled because of the space problems. Prior to taking a load of these wastes to the landfill, the Allegheny County Health Department must be notified and approval obtained.

Category (3) wastes include reactive chemicals and known carcinogens which are destroyed on site, if possible. Examples of these are various peroxides, mercury, strong acids, and asbestos. The peroxides are burned on site while mercury is recovered and sold. Strong acids are neutralized, and if heavy metals are present, they are precipitated out. Asbestos wastes are separated out and placed into special impervious containers, which are also taken to the Findlay Township landfill.

Category (4) wastes consist of radioactive wastes. These wastes are taken to another plant of the parent company, where they are disposed of at a Nuclear Regulatory Commission approved burial site.

Category (5) wastes consist of normal daily refuse, such as paper towels, uncontaminated filter paper, cardboard, etc. These wastes are placed in dumpsters and hauled away by Browning-Ferris Industries to the daily landfill in Findlay Township.

Scrap oil is the major constituent of Category (6) wastes. These oily wastes are stored in drums which are periodically picked up by a private contractor and reprocessed.

Company B

Daily refuse collection for Company B is performed by several private contractors, with Browning-Ferris Industries as the largest. Outdated or contaminated chemicals and solvents, as well as "hazardous wastes", are handled by RAD Services Incorporated. They supply personnel and materials to identify, categorize, and remove the waste chemicals. They also supply Department of Transportation approved containers and vermiculite for packaging the various individual containers into drum quantities. Before packaging, the chemicals are separated into compatible groups to minimize reactions in the event of bottle leakage. The drums are sealed, labeled, and loaded into vehicles according to D.O.T. and OSHA rules and regulations. Wastes are then transported from Company B to RAD Services warehouses for consolidation into larger truckload shipments for final disposal. The disposal sites, which are not owned by RAD Services, Inc., consist of the following: 1) resource resale and recovery facilities, 2) incineration facilities, and 3) secure chemical burial sites.

Industry C

Up until February of 1978, all laboratory wastes were put into 55 gallon drums and landfilled. This work was done by Long Hauling, Inc., a private contractor. Currently a new classification system is being initiated by the Company. The new system segregates wastes into four divisions: Class A, B, C, and D. It is the responsibility of the laboratory personnel to separate these wastes and dispose of them in the appropriately marked containers. Class A contains clean, flammable liquids, such as hexane, acetone, toluene, xylene, methanol, propanol, and methyl-ethyl-ketone. These liquids account for 70% of the laboratory wastes and are incinerated by the ARCO Polymer Plant in Monaca, Pennsylvania. Class B wastes conists of viscous materials containing mainly mixed polymers, such as styrene based polymers, ethylene based polymers, and coal based tars. Class C wastes are composed of both liquids and solids which are either strongly acidic or caustic. Both class B and C materials will be landfilled. Class D wastes are the "more hazardous" wastes which are disposed of on a case by case basis.

Industry D

Laboratory wastes from the research laboratories of Industry D are divided into four categories. Class (1) wastes are flammable solvents which are collected in the laboratory, put into 55 gallon drums, and landfilled by a private contractor. Class (2) wastes, the "hazardous fraction" are picked up by Radiac Research Corporation from New York City. Radiac follows a procedure similar to RAD Services, in that wastes are placed into small drums which are packed with vermiculite. These wastes are then disposed of at various approved hazardous landfills. Class (3) wastes contain glass materials and Class (4) materials contain other laboratory wastes, such as filter paper, paper towels, etc. Both Class (3) and (4) wastes are landfilled by a private contractor.

Industry E

Industry E segregates its laboratory wastes into three main categories. The uncontaminated everyday wastes, such as paper, shavings, and cardboard, are collected by a local contractor, Sabatini Refuse Service. These wastes are landfilled at a location in Harrison Township, Pa. All sanitary wastes and a large part of the chemical wastes from the research center are treated by Industry E at their own treatment plant. Resulting chromium , solids, outdated chemicals, strongly acidic and caustic solutions, "hazardous"materials, and any other chemical wastes which are not treated at the treatment plant, are placed in appropriate containers, labeled, and hauled away by Chem-Dyne Corporation, for disposal or resource recovery. The majority of their hazardous landfilling is done at an approved hazardous waste landfill in the Cleveland, Ohio area.

Industry F

Industry F has a small research center whose laboratory wastes are primarily paper and cardboard. These wastes are hauled to a nearby plant and are incinerated in the boiler house to produce steam. Any scrap metal is also taken to a processing plant and recycled. Any chemical wastes which accumulate in the lab are periodically dumped into an open field at the research center.

Industry G

Industry G has their own sanitary and chemical treatment plants. The sanitary system consists of a comminutor, Imhoff tank, trickling filter, chlorination, secondary sedimentation, and an equalization tank with aeration and an oil skimmer. At this point the sanitary wastes are combined with chemical wastes which have previously gone through three API oil separators. The chemical wastes from this facility consist mainly of water with oil. Following equalization, the combined wastes go through a chlorine contact basin and the final effluent goes to a small creek which empties into a major river. The sludges from the treatment systems are used as mulch and landfill on the research center property. The normal refuse wastes are collected by Sabatini Refuse Service and landfilled. Water which is produced as the result of various pilot plant studies was disposed of in the past by evaporation in ponds at the research center, but is now also disposed of by Sabatini. Slop oil which is produced in the pilot plant is incinerated on site, while gases such as methane, hydrogen sulfide, carbon monoxide, and carbon dioxide, are burned in the boiler house with air and natural gas to produce useable utility steam. Coal and ash wastes are placed into steel drums and are disposed of by AMO Pollution Services. Naptha wastes are stockpiled on the property with the hope that they will eventually be able to find a buyer. Approximately 10,000 gallons of this waste is now in storage, and if no buyer is eventually found, these wastes will also be disposed of by AMO Pollution Services.

Industry H

The daily trash from the research center is collected and hauled away by Browning-Ferris Industries. Browning-Ferris will also take outdated and contaminated chemicals, as well as "hazardous" materials, but personnel from the research center must identify potential hazards from each item. Browning-Ferris then forwards this information to the DER office in Harrisburg, where they are advised as to the appropriate disposal of these particular items. This research center is now in the process of switching over to RAD Services, Inc., who will identify, label, and transport these "hazardous" wastes to various locations.

As can be seen from the above survey of "local practice", a variety of techniques are used for waste segregation and disposal. In an attempt to save money for haulage and disposal, several companies have instituted a policy of incineration for flammable solvents. These practices are reflected in their particular segregation scheme. Hazardous waste incineration on a continuing basis may prove more viable for the Bruceton-DOE site as a whole, rather than just for the PETC-ERDA facility, particularly as the direct liquefaction and SYNTHANE demonstration facilities become more operational.

INCINERATION: CLASSIFICATION BY WASTE COMPOSITION AND INCINERATION TYPES

The purpose of incineration, as used in the context of hazardous waste disposal, is to convert environmentally unacceptable materials to a state such that residuals upon oxidation may be deposited in the environment as non-hazardous wastes without causing adverse impacts.

The following are classifications of materials often incinerated:

Type 0 - Trash, a mixture of highly combustible waste such as paper, cardboard, cartons, wood boxes, and combustible floor sweepings, from commercial and industrial activities. The mixtures contain up to 10% by weight of plastic bags, coated paper, laminated paper, treated corrugated cardboard, oily rags and plastic or rubber scraps.
This type of waste contains 10% moisture, 5% incombustible solids, and has a heating value of 8500 B.T.U. per pound as fired.

Type 1 - Rubbish, a mixture of combustible waste, such as paper, cardboard cartons, wood scrap, foilage and combustible floor sweepings, from domestic, commercial and industrial activities. The mixture contains up to 20% by weight of restaurant or cafeteria waste, but contains little or no treated papers, plastic or rubber wastes.
This type of waste contains 25% moisture, 10% incombustible solids, and has a heating value of 6500 B.T.U. per pound as fired.

Type 2 - Refuse, consisting of an approximately even mixture of rubbish and garbage by weight. This type of waste is common to apartment and residential occupancy, consisting of up to 50% moisture, 7% incombustible solids, and has a heating value of 4300 B.T.U. per pound as fired.

Type 3 - Garbage, consisting of animal and vegetable wastes from restaurants, cafeterias, hotels, hospitals, markets, and like installations. This type of waste contains up to 70% moisture, up to 5% incombustible solids, and has a heating value of 2500 B.T.U. per pound as fired.

Type 4 - Human and animal remains, consisting of carcasses, organs and solid organic wastes from hospitals, laboratories, abattoirs, animal pounds, and similar sources, consisting of up to 85% moisture, 5% incombustible solids, and having a heating value of 1000 B.T.U. per pound as fired.

Type 5 - By-product waste, gaseous, liquid or semi-liquid, such as tar, paints, solvents, sludge, fumes, etc. from industrial operations. B.T.U. values must be determined by the individual materials to be destroyed.

Type 6 - Solid by-product waste, such as rubber, plastics, wood waste, etc., from industrial operations. B.T.U. values must be determined by the individual materials to be destroyed.

Incineration Classifications:

The following are classifications of incinerators based on materials incinerated and rate of incineration:

Class I - Portable, packaged, completely assembled, direct fed incinerators, having not over 5 cubic feet storage capacity, or 25 lbs. per hour burning rate, suitable for Type 2 wastes.

Class IA - Portable, packaged or job assembled, direct fed incinerators, 5 cu. ft. to 15 cu. ft. primary chamber volume; or a burning rate of 25 lbs per hour up to, but not including 100 lbs per hour of Type 0, Type 1, or Type 2 waste; or a burning rate of 25 lbs. per hour up to, but not including 75 lbs. per hour of Type 3 waste.

Class II - Flue-fed, single chamber incinerators with more than 2 sq. ft. burning area, for Type 2 Waste. This type of incinerator is served by one vertical flue functioning both as a chute for charging waste and to carry the products of combustion to atmosphere. This type of incinerator has been installed in apartment houses or multiple dwellings.

Class IIA -Chute-fed multiple chamber incinerators, for apartment buildings with more than 2 sq. ft. burning area, suitable for Type 1 or Type 2 waste. (Not recommended for industrial installations). This type of incinerator is served by a vertical chute for charging wastes from two or more floors above the incinerator, and a separate flue for carrying the products of combustion to atmosphere.

Class III -	Direct fed incinerators with a burning rate of 1000 lbs. per hour and over, suitable for Type 0, Type 1 or Type 2 waste.
Class IV -	Direct fed incinerators with a burning rate of 75 lbs. per hour or over, suitable for Type 3 waste.
Class V -	Municipal incinerators suitable for Type 0, Type 1, Type 2, or Type 3 wastes, or a combination of all four wastes, and are rated in tons per hour or tons per 24 hours.
Class VI -	Crematory and pathological incinerators, suitable for Type 4 waste.
Class VII -	Incinerators designed for specific by-product wastes, Type 5 or Type 6.

Based upon observations to date for the nature of residuals generated from the PETC-Bruceton site, it appears that a Class VII incinerator would be most applicable. Of the types of Class VII incinerators available, liquid injection incinerators, fluidized bed incinerators, or rotary kiln incinerators, should be initially investigated (2).

It may be observed that the costs for thermal destruction of hazardous solid wastes in specially built facilities are greater than those presently incurred by land disposal, however, the probability of future liability occurring, as may be the case even with "secure burial" facilities, is negligible. From a policy point of view, the principal investigator of this research favors the incineration of hazardous materials when possible, primarily due to the mitigation of future potential environmental accidents occurring when these wastes are stored for perpetuity. Such incinerators should, of course, be provided with appropriate time-temperature characteristics in the fire box, and be equipped with particulate and gaseous air pollution control devices as necessary to be considered as "Level III technology".

Secure Landfill

An annotated literature search of the interaction and generation of municipal landfill leachate and gas migration is outlined by Pohland and Engelbrecht (4). As illustrated by this and similar reports, there is considerable research in the area of chemical and biological characterization of municipal leachate, however, comparatively little data exists dealing with industrial or hazardous waste landfill leachate.

When hazardous wastes cannot be recycled, incinerated, or detoxified by chemical means, land burial and isolation must be considered (5). Adverse effects which may be noticed at any time in the future include:

a) ground water contamination due to organic and inorganic (including soluble salt) leaching

b) surface water contamination due to overland runoff

c) air pollution via volatilization of organics

d) underground fires and explosions

Isolation of "chemical burial vaults" from the surrounding environment may be provided by compacted clay liners, supplemented with impervious asphalt, plastic or other synthetic polymeric membrane materials. Battelle(5) outlines pertinent considerations of geology, hydrology, soil properties, climatology, environmental health, and ecology, for use in evaluation and siting of secure chemical burial vaults.

PETC should consider as an overall objective in hazardous waste landfill site evaluation, the degree of insulation that in-place materials have from surroundings, and the continual activities of site personnel in leachate well monitoring and chemical analysis of leachate. A brief but pertinent discussion of monitoring techniques for these purposes is presented by Farb (6). The concepts applied to the PETC-Bruceton site on a small scale should equally be applied to disposal of materials from demonstration and commercial sized coal conversion facilities.

APPLICATION TO DEMONSTRATION AND COMMERCIAL SIZED COAL CONVERSION FACILITIES

Much attention in the past has been given to the prevention and treatment of leached contaminated drainage from coals and coal refuse dumps, primarily in the area of acid mine drainage. In general, the influx of water is limited through such sites mainly by grading and compaction of the overburden. Contaminated drainage is treated by pH neutralization and precipitation when possible of dissolved salts. In some cases dissolved salts are removed via ion exchange, reverse osmosis, or flash evaporation[7]. Such technologies are expensive and as such are avoided for common use for today's environmental control purposes. Application to coal conversion facilities, if needed, should similarly prove costly.

The major problem areas from a technical control viewpoint, relative to coal conversion waste residuals, are potentially toxic trace elements from chars, slags, and ash-like material, and potentially toxic trace organics from tars, spent catalysts, and sludges.

The chemical, physical and leaching properties, of the ash may differ significantly from power plant ashes since some are formed in a reducing rather than oxidizing atmosphere. A typical 250 million cubic ft/day gasification plant may produce 2,000 to 5,000 tons per day of this ash, and 200 to 300 tons per day of tar, depending on the influent coal composition and specific process used.

The characterization, fate, and path of these pollutants through the environment, and their linkages to human health and environmental degradation, is not as yet well defined. In addition, it is uncertain as to the impact of the disposal of these residuals on the land and subsequent land use.

In accord with the unknowns associated with coal conversion solid waste disposal, the University of Pittsburgh, with DOE support, shall continue its program of evaluating some of these problem areas. As part of this research effort, the University intends to conduct organic and inorganic leaching evaluations and modeling of pollutant migration from sample coal conversion residuals, with preliminary assessment of the potential toxicity of such leachate. This research is deemed important in both the short term and long term for the development of technically and economically viable technologies for assessing and controlling the environmental impacts associated with coal conversion solid waste disposal.

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1) Public Law 94-580, "Resource Conservation and Recovery Act of 1976", also cited as the "Solid Waste Disposal Act", October 21, 1976

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3) EPA SW-118-c, "Assessment of Industrial Hazardous Waste Practices: Organic Chemicals, Pesticides, and Explosives Industries", (contract #68-01-2919), 1976

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APPENDIX A

Letter from DER to California State College re : Disposal Procedures for Laboratory Chemicals

COMMONWEALTH OF PENNSYLVANIA

DEPARTMENT OF ENVIRONMENTAL RESOURCES
Division of Solid Waste Management
95 West Fayette Street
Uniontown, Pennsylvania 15401

August 26, 1977

Garry Lynch
Box 606
Rostraver Br.
Belle Vernon, PA 15012

Re: Disposal Procedures for
Small Amounts of Common
Chemicals
(Chem Lab Quantities)

Dear Mr. Lynch:

Thank you for your inquiry concerning disposal of old and contaminated chemicals from the chem lab at California State College. It is not, of course, possible to list disposal of each specific chemical; therefore, disposals are categorized by chemical classes. The disposal/recovery procedures described in this letter have been tested and approved by the Safety and Fire Protection Committee of the Manufacturing Chemists Association. The techniques described herein were developed to assist lab personnel in developing an awareness of chemical hazards and in fulfilling their responsibilities to dispose of chemical wastes without personal injury, without hazardous adulteration of drains, and without excessive contamination of ground, air, or water. Recommended disposal procedures for some of the more common lab chemicals follows:

ORGANIC ACID HALIDES

Examples:

Acetyl bromide, Acetyl chloride, benzene sulfonyl chloride, benzoyl chloride, butyryl chloride, chloro acetyl chloride, 3-Chloropropionyl chloride, O-Chlorobenzoyl chloride, Crotonyl chloride, Dichloro acetyl chloride, oxalyl chloride, Propionyl chloride, Trichloro acetyl chloride.

Disposal - Package Lots

Slowly sift or pour into a large glass or plastic vessel containing a layer of sodium bicarbonate, mix thoroughly, and add slowly to a large container of water with stirring. Slowly pour this mix down the drain with copious amounts of water.

INORGANIC HALIDES

Examples: Anhydrous aluminum bromide, anhydrous aluminum chloride, chlorosulfonic acid, ferric chloride hexa hydrate, germanium tetrachloride, silicon tetra chloride, stannic chloride, tin tetrachloride, titanium tetrachloride.

Disposal - Package Lots

Sift or pour onto a dry layer of sodium bicarbonate in a large evaporating dish. After mixing thoroughly spray with 6M-NH_4OH while stirring. Cover with a layer of crushed ice and stir. Continue spraying with 6M-NH_4OH. When the smoke of NH_4Cl has partly subsided add iced water and stir. Dump this slurry into a large container. Repeat ontil all has been treated. Neutralize* and slowly siphon the suspension into the drain with excess water.

* If excess of 6M-NH_4OH has been used, neutralize with 6M-HCl (use litmus paper indicator). If acidic, neutralize with 6M-NH_4OH.

ALDEHYDES

Examples:

Acetaldehyde, Acrolein, Acrolein dimer, O-Anisaldehyde, benzaldehyde, butyraldehyde, capryaldehyde, chloral, chloralhydrate, chloroacetaldehyde, cinnamaldehyde, Crotonaldehyde, isodecaldehyde, 2 ethyl-3-propylacrolein, Formaldehyde, Furfural, glutaraldehyde, glyoxal, para Formaldehyde, Paraldehyde, propionaldehyde, salicylaldehyde.

Disposal - Package Lots (Choice of procedures)

1. Absorb on vermiculite. Burn in an open pit or open incinerator.

2. Dissolve in a flammable solvent (such as acetone or benzene). Spray into the fire box of an incinerator equipped with an after burner.

ALKALI AND ALKALINE EARTH METALS, METAL ALKYLS, AND ALKOXIDES

Examples:

Aluminum alkyls, aluminum ethoxide, n-Butyllithium, Calcium Chlorodiethylaluminum, diethyl zinc, Lithium, Potassium, sodium-potassium alloys, triethyl aluminum, Triisobutyl Aluminum.

Disposal- Package Lots

Mix with dry soda ash. Scoop into dry bucket. In a remote area spread onto a large iron pan. Cover with scrap wood, paper and ignite with an excelsior train.

OR - Burn in an open pit incinerator.

OR - Direct "dry" steam onto the waste, spread on an iron pan. Beware of splatter.

WARNING: Possible Violent Reaction With Water.

ORGANIC HALOGEN AND RELATED COMPOUNDS

Examples:

Aldrin, Allyl chloride, benzal chloride, Bromobenzene, n-butyl chloride, chlordane, chlorobenzene, chlorocresols, chloronaphthalene, 1,1-Dichloroethane, Dieldrin, Dodecyl sodium sulfate, Ethyl fluoride, Lindane Methoxychlor, Methyl chloride, octafluoropropane, Pentachlorophenol, tetraethyl lead, 1,2,4- trichlorobenzene, vinyl chloride.

Disposal - Package Lots (Choice of Procedures)

1. Pour onto vermiculite, sodium bicarbonate, or a sand- soda ash mixture (90-10). (If a fluoride is present, add slaked lime to the mixture.) Mix and shovel into paper boxes. Place in an open incinerator. Cover with scrap wood and paper. Ignite with an excelsior train; stay on upwind side: OR dump into a closed incinerator with an afterburner.

2. Dissolve in a flammable solvent. Spray into the fire box of an incinerator equipped with an afterburner and alkali scrubber.

AROMATIC AMINES

Examples.

Acridine, 2-aminodiphenylene oxide, aniline, anisidines, aziridine, Benzidine*, 2-biphenyl amine, 1,2,5,6- Di benzcarbazole, 3,3'-dimethorybenzidine*, Morpholine, 2- Naphthyamine*, Nicotine, Picolenes,Pyridine, Quinoline, Strychine, toluidines, Xylidines.

*Carcinogenic

Disposal - Package Lots (Choice of Procedures)

1. Pour or sift onto a thick layer of sand and soda-ash mixture (90-10). Mix and shovel into a heavy paper box with much paper packing. Burn in an incinerator. Fire may be augmented by adding excelsior and scrap wood. Stay on upwind side.

2. Waste may be dissolved in flammable solvent (alcohol, benzene, etc.) and sprayed into fire box of an incinerator with an afterburner and scrubber.

AROMATIC HALOGENATED AMINES AND NITRO COMPOUNDS

Examples:

Brucine, Carbazole, 1-chloro-2,4-dinitro-benzene, Chloro-nitroanilines, Chloro-nitrobenzene, Chlorophenols. Dichlorobenzene, 3,3'-Dichlorobenzidine*, Dinitroaniline, Dinitrobenzene**, 2,4-Dinitrophenol**, 2,4-Dinitrotoluene**, Endrin, 4Fluoro-4-biphenylamine, Methyl isothiocyanate, 1Methyl-1-nitrosourea, 1-Methyl pyrole, Nitrobenzene, Nitrophenols, Picric acid**, Trinitrobenzene**, Trinitrotoluene**.

Disposal - Package Lots (Choice of Procedures)***

1. Pour or sift onto sodium bicarbonate or a sand-soda ash mixture (90-10). Mix and package in heavy paper cartons with plenty of paper packing to serve as fuel. Burn in an incinerator. Fire may be augmented with scrap wood.

2. The packages of #1 may be burned more effectively in an incinerator with after burner and alkaline scrubber.

3. The waste may be mixed with a flammable solvent (alcohal, benzene, etc.) and sprayed into a fire chamber of an incinerator with after burners and alkaline scrubber.

*Carcinogenic

**Explosive. Other Nitro Compounds May Also Be Unstable.

***Destruction by chemical decomposition is recommended for dinitro, trinitro, and other compounds with explosive potential.

Add the material slowly, while stirring, to 30 times its weight of a solution prepared by dissolving 1 part sodium sulfate ($Na_2S \cdot 9H_2O$) in 6 parts of water.

For unstable acidic materials (e.g. Picric Acid), dissolve in 25 times its weight of a solution made from 1 part NaOH and 21 part sodium sulfide in 200 parts of water. Some H_2S and NH_3 is evolved.

ALIPHATIC AMINES

Examples:

Allyl amine, Amyl amine, Butyl amine, Dicyclohexylamine, Ethanolamine, Hexamethylenetetramine, Lutidine, N Nitrosodimethylamine*, Propyl amines, Tri-ethylamine.

*Carcinogenic

Disposal - Package Lots (Choice of Procedures)

1. Add the contaminated amine to a layer of sodium bisulfate in a large evaporating dish. Spray with water. Make neutral and wash into the drain with a large excess of water.

2. Dissolve in a flammable solvent (e.g., waste alcohols). Burn in an open pit by means of an excelsior train. Stay on upwind side.

3. Solution of #2 may be spread into the fire box of an incinerator with an afterburner and scrubber.

ORGANIC PHOSPHATES AND RELATED COMPOUNDS

Examples:

O-Chlorophenyl diphenylphosphate, Diethyl ethyl phosphate, Grain Fumigants, Hydroxy dimethyl arsine oxide, Malathion, Parathion, Phosdrin, Ronnel, Systox, Triphenyl phosphate, Triphenyl phosphine.

Disposal - Package Lots (Choice of Procedures).

1. Take packages to an open incinerator. Stay on upwind side and mix equal parts of sand and pulverized limestone. Wet down with a flammable solvent (benzene or alcohol). Ignite from a safe distance with an excelsior train.

2. Shovel mixture of #1 into a paper box and drop into an incinerator with an efficient afterburner. Alkaline scrubber will prevent escape of any oxides of phosphorous and arsenic.

AZIDES AND AZO-COMPOUNDS

Examples:

2, 2'- Azonaphthalene, Azoxybenzene, Diazo methane, Hydrazoic acid, 1-ortho-tolyazo-2-naphthol, Sodium azide.

Disposal - Package Lots (Choice of Procedures)

Note: The organic azides and heavy metal azides are explosive. Alkali and alkaline earth azides are not considered explosive under normal laboratory conditions.

1. "Kill" by adding to a greater-than-stoichiometric amount of ceric ammonium nitrate solution with agitation sufficient to provide suspension of all solids. Cool the reaction.

OR

Dissolve in water to ensure an azide concentration of less than 5%. Add a 20% solution of sodium nitrate- 1½ lbs. $NaNO_2$ to 1 lb. azide (or equivalent). Mix well. Very slowly and with continuous stirring (good ventilation required) add a 20% solution of H_2SO_4 until the waste is just acid to litmus. Toxic oxides of nitrogen are given off. When acidified solution turns starch iodide paper blue excess nitrite is present and decomposition is complete.

CARBON DISULFIDE

Disposal -Package Lots

All equipment on contact surfaces should be grounded to avoid ignition by static charge. Absorb on vermiculite, sand, or ashes and cover with water. Transfer under water in buckets to an open area. Ignite from a distance with an excelsior train. If quantity is large, carbon disulfide may be recovered by distillation and repackaged for use.

CAUSTIC ALKALI AND AMMONIA

Examples:

Anhydrous ammonia, Calcium hydroxide, Calcium oxide, Potassium and sodium hydroxide.

Disposal - Package Lots

Pour into a large tank and neutralize. Transfer to sewer with large excess of water.

INORGANIC SALTS

Examples:

Alums, Ammonium thiocyanate, Chromic (III) salts (hydrates), Copper nitrate, Ferrous sulfate, Manganese sulfate, Molybdenum compounds (Sol.), Potassium acetate, Sodium Benzoate, Sodium hydrogen difluoride, Stannic chloride hydrate, Zinc chloride.

Disposal - Package Lots

Add slowly to a large container of water. Stir in slight excess of soda ash. If fluoride is present add slaked lime also. Let stand 24 hours. Decant or siphon into another container and neutralize with 6M-HCl before washing down drain with large excess of water. The sludge may be added to a landfill.

OXIDIZING AGENTS

Examples:

Ammonium dichromate, Ammonium perchlorate, Bromic acid, Bromine, Calcium hypochlorite, Chlorine, Fluorine, Iodine, Nitrosyl chloride, Perchloric acid.

Disposal - Package Lots

Add a large volume of concentrated solution of reducer (hypo, a bisulfate, or a ferrous salt and acidify with 3M-H_2SO_4). When reduction is complete add soda ash or dilute hydrochloric acid to neutralize the solution. Wash into drain with a large excess of water.

REDUCING SUBSTANCES

Examples:

Chromous salts, Sodium bisulfate, Sodium sulfite, Stannous chloride, Sulfur dioxide.

Disposal - Package Lots

If a gas bubble into soda ash solution. If a tank of reducing gas has developed a permanent leak, lower it upside down filled with water. Add a mixture of soda ash and calcium hypochlorite. Continue the treatment until the tank is empty and the drum contains a solution of stable element or compound.

If a solid, mix with equal volume of soda ash and add water to form a slurry in a large container. In either case add calcium hypochlorite. Add more water if necessary and let stand two hours. Neutralize the oxidized solution with either 6M-HCl or 6M-NaOH as indicated by litmus paper test. Wash down the drain with large excess of water.

CYANIDES AND NITRILES

Examples:

Aceto-nitrile, Benzonitrile, Calcium cyanide, Cuprous cyanide, Cyanogen, Lactonitrile, Potassium cyanide, Propionitrile, Sevin, Succinonitrile.

Disposal - Package Lots (Choice of Procedures)

1. Add the cyanide with stirring to strong alkaline solution of calcium hypochlorite. Maintain an excess of sodium hydroxide and calcium hypochlorite. Let stand 24 hours. Flush the cyanate down the drain with large excess of water. (Not preferred.)

2. Add sufficient alkalinity, usually $Ca(OH)_2$ or NaOH, to bring the waste to a pH of about 11, thus ensuring the complete oxidation of the cyanide. While bubbling chlorine gas into the solution, violentl agitate to prevent the cyanide salt of sodium or calcium from precipitating out prior to oxidation. About 6 lbs. of caustic and chlorine are normally required to oxidize 1 pound of CN to N_2. A full 24 hours chlorination period is usually required to effect complete oxidation.

3. Nitrites are more effectively converted to soluble cyanate by treating with excess alcoholic sodium hydroxide. After about one hour evaporate the alcohol and then add calcium hypochlorite. Maintain an excess of hydroxide and hypochlorite. After 24 hours flush the cyanate down the drain with a large excess of water.

HYDROCARBONS, ALCOHOLS, KETONES, AND ESTERS

Examples:

Acetone, Allyl alcohol, Amylene, Benzene, Butadiene, Cresols, Cyclohexene, p-Cymene, Diethyl phthalate, Ethane, Ethylene, Furan, Greases, Hexane, Kerosene, Ligrain, Methane, Methyl butyl ketone, Napthas, Nickel carbonyl, Octane, Pentane, Phenol, Propylene, Rotenone, Styrene, Toluene, Turpentine, Xylenes.

Disposal - Package Lots

1. A gas- Pipe into the incinerator or lower into a pit and allow to burn away.

2. A liquid- Atomize into an incinerator. Combustion may be improved by mixing with a more flammable solvent.

3. A solid- Make up packages in paper or other flammable material. Burn in an incinerator. The solid may also be dissolved in a flammable solvent and sprayed into the fire chamber.

ETHERS

Examples:

Anisole, Chloromethyl Ether, Dimethoxy methane, Ethyl ether, Phenyl ether, Tetrahydrafuran.

Disposal - Package Lots

1. Pour on ground in open area. Allow to evaporate or ignite from a distance by means of a long fuse or excelsior train.

2. Dissolve waste in higher alcohol (e.g., butyl), benzene, or petroleum ether. Incinerate.

3. PEROXIDE FORMATION. Ether of long standing in contact with air and exposed to light may contain peroxides, especially if stored in clear glass. Explosions have occured when caps or stoppers were turned.

Transport cans or bottles to an isolated area (e.g., deserted quarry) Wrap each container in padding material or pack in sawdust. At site uncover and arrange an explosive train. From a safe distance puncture the cans near the bottom with rifle fire. Ignite excelsior train. Observe local regulations.

INTER NON-METALLIC COMPOUNDS

Examples:

Boron trichloride, Carbonyl fluoride, Nitric oxide, Phosgene, Phosphorous pentasulfide, Sulfuryl chloride.

Disposal - Package Lots

Sprinkle or sift onto a thick layer of mixed dry soda ash and slaked lime (50-50) from behind a body shield. Mix and spray water cautiously with an atomizer. Beware of flash fire. Scoop up and sift cautiously into a large volume of water. Neutralize with either 6M-NH_4OH or 6M-HCl as determined by a litmus test and wash down drain with large excess of water.

ORGANIC PEROXIDES

Examples:

Acetyl peroxide, 3,4-dichlorobenzoyl peroxide, Lauroyl peroxide, Methyl ethyl ketone peroxide.

Disposal - Package Lots

Absorb or mix in small portions on vermiculite or sand. Wet down with 10% NaOH. Scoop up with plastic scoops and take to an incinerator and burn.

INORGANIC SULFIDES

Examples:

Ammonium sulfide, Calcium sulfide, Potassium sulfide.

Disposal - Package Lots

Eliminate all sources of ignition. Add to a large volume of $FeCl_3$ solution and stir until FeS formation is complete. Add soda ash while stirring until neutral. Scoop up and wash down drain with excess water.

ORGANIC ACIDS (Limited to C, H, and O compositions)

Examples:

Acetic acid, Benzoic acid, Fumaric acid, Lauric acid, oleic acid, oxalic acid, pyruvic acid, salicylic acid, tannic acid.

Disposal - Package Lots (Choice of Procedures)

1. Liquid acid may be injected at base of incinerator or after mixing with a flammable solvent.

2. Solid acid may eb dissolved in a flammable solvent and burned as above.

Because of the high toxicity of the following elements and compounds, recovery is essential.

MERCURY

Examples:

Mercuric nitrate, chloride, and thiocyanide, Mercury, organic mercury compounds.

Recovery - Spills and Package Lots

Metal: Collect all droplets and pools at once by means of a suction pump and aspirator bottle with a long capilary tube. Cover fine droplets in nonaccessible cracks with calcium polysulfide and excess sulfur. Combine all contaminated mercury in a tightly stoppered bottle. Hold for purification or sale.

Compounds: Dissolve all water soluble compounds. Convert other contaminated compounds to the soluble nitrates. Adjust the acidity and precipitate as mercuric sulfide. Wash and dry the precipitate and ship to supplier.

PHOSPHOROUS, YELLOW AND RED

Spills- Yellow Phosphorous: Cover with wet sand. Spray with water to keep sand wet. Scoop into bucket of water. After it stands overnight, recover and repackage.

OR

If quantity is small (e.g., fragments of sticks), cover with water and remove to an open area. Pour onto ground or a steel pan. The water will evaporate and dry yellow phosphorous will ignite spontaneously in air and burn away.

Spills- Red Phosphorous: Sweep up and burn on an iron pan in the hood.

ARSENIC, ANTIMONY, AND BISMUTH

Examples:

Antimony, pentasulfide, Arsenic acid, Calcium arsenate, Metals of above elements, nitrates and chlorides of arsenic, antimony, and bismuth.

Recovery:

Dissolve in a minimum of concentrated hydrochloric acid. Filter if necessary. Dilute with water until white precipitates form (SbOCl and BiOCl). Add just enough 6M-HCl to redissolve. Saturate with hydrogen sulfide. Filter, wash the precipitate, package, and ship to supplier.

OR

If of very little value, use disposal procedure for inorganic salts.

SELENIUM AND TELLURIUM

Recovery

Make a solution strongly acidic with hydrochloric acid. Slowly add sodium sulfite to the cold solution while stirring, thus producing sulfur dioxide, the reducer. Upon heating, dark gray selenium and black tellurium form. Let stand overnight. Filter, dry, and ship to supplier.

LEAD AND CADMIUM COMPOUNDS

Recovery:

Convert to nitrates with a minimum of concentrated nitric acid. Evaporate in a fume hood to a thin paste. Add about 500 ml. water and saturate with hydrogen sulfide. Filter, wash, and dry the precipitate and ship to supplier.

OR

If waste is of small volume, use procedure for disposal of inorganic salts.

BERYLLIUM COMPOUNDS

Recovery:

Dissolve in a minimum of 6M-HCl. Filter and treat filtrate with excess of 6M-NH_4OH (use litmus). Boil and allow coagulated precipitate to settle for about 12 hours. Filter, dry, package, and ship to supplier.

STRONTIUM AND BARIUM COMPOUNDS

Recovery:

Dissolve waste in 6M-HCl and filter. Neutralize with 6M-NH_4OH (use litmus) and precipitate with excess sodium carbonate. Filter, wash, and dry the precipitate. Package and ship to supplier.

OR

If waste is of small volume, follow disposal procedure for inorganic salts.

VANADIUM COMPOUNDS

Recovery:

Work in a fume hood. Add (e.g., $VOCl_3$) slowly to a thick layer of powdered ammonium carbonate in a large evaporating dish. Spray with 6M-NH_4OH while stirring. Add a layer of crushed ice and continue stirring and spraying. Add more 6M-NH_4OH if necessary. May add more waste vanadium compound with stirring. Pour into large beaker and let stand overnight. Filter off crude ammonium vanadate, dry, package, and ship to supplier.

HALOGENATED SOLVENTS

Examples:

Bromoform, Carbon tetrachloride, Chloroform, 1,1,1-Trichloroethane, Trichloroethylene.

Recovery:

The toxic liquid compounds concerned are insoluble in water and cannot be burned. Purify the contaminated liquids by distillation and place pure distillate back on shelf.

OR

Return to supplier.

When disposing of any chemicals, it is imperative that you be provided with proper safety equipment to protect yourself from injury or unnecessary exposure to toxic chemicals. At a minimum, safety equipment available should include rubber and neoprene gloves, self contained breathing apparatus or an effective hood with full face shield, Carbon Dioxide and Class A fire extinguishers, large heavy face shield, lab coat and fireproof clothing, and safety glasses.

As a word of precaution, the various waste classes listed should be disposed of separately. Mixing wastes can produce hazardous situations through heat generation, fires, explosions, or release of toxic substances.

It is hoped that you will use this information judiciously. If you do not have adequate facilities or if you are in doubt concerning disposal of any wastes, you should return the unused portion of the chemical to the suppliers.

Very truly yours,

Mark Frederick
Solid Waste Specialist

MF/mi

cc: Fayette County Office
Pittsburgh Office
Central Office

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