The Management of Toxic or Hazardous "Liquid", Semi-Solid and Industrial Wastes

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INTRODUCTION

One of the most serious pollution problems facing the Solid Wastes Management Industry is the collection, transport and disposal of so-called Liquid Wastes. It is a serious problem because these wastes pose a potential pollution threat far greater than present levels, and, if improperly managed, this threat could persist for many years. It crosses the boundaries of air and water media pollution in many ways through emissions to the atmosphere and pollution of surface or underground waters. The wastes are produced in varying kinds and amounts everywhere in proportion to industrial and commercial activities.

Traditionally, these wastes have been handled by storage, by discharge into streams, by haphazard dumping, by barging to sea, and, surreptiously, down municipal sewers into treatment systems. Because of actual and potential serious pollution of surface or underground waters by these practices, water pollution regulatory authories have imposed numerous guidelines and regulations and generally require specific procedures and approval for the disposal of these liquid wastes in Sanitary Land-fills as shown in the tabulation of the requirements of the several states given in Table 1. In the final analysis the producer and those who handle these wastes are held responsible for any pollution which may result in the collection, transport and disposal of them.

DEFINITION

A definition of "liquid" industrial wastes within Solid Wastes Management regimes is not easy because they are not all Liquid nor Solid, nor even semi-solid. Some are liquid when produced and solidify on standing or cooling, while others are solids, indeed. The terminology becomes even more difficult in defining toxic or hazardous materials because practically all substances could be toxic if the concentration or quantity is sufficiently large. Synonyms are poisonous or noxious, sludges, slurries and tars and other terms, printable only in school papers. They are the residues, by-products, and unsalable products from manufacturing for which there is no futher economic use and they include the concentrated pollutants from air and water cleaning operations. These will increase in proportion to the effectiveness of pollution abatement programs and decrease in proportion to the economics and practicality of recycling procedures. Radio-active wastes and explosives fall into separate categories, but substances capable of exploding are included.

Figure 1 shows how centralized disposal plants fit into "*A Systems Approach* of the Generation, Treatment and Disposal of Industrial Wastes." This approach is a project of the Incinerator Division of the Industrial Committee ASME. [1] The Study is expected to be a continuing project by three task

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TABLE 1 – STATE REGULATIONS
SANITARY LANDFILL DISPOSAL OF "LIQUID" WASTES

State	Solid Waste Regulations	Specific "Liquid" Waste Regulations	Approval Req'd. Liquid Wastes	Reports Legally Required
Alabama	(1969)	Yes	Yes	No
Alaska	In Process	In Process	––	––
Arizona	(1962)	No	Yes	No
Arkansas	(1971)	Yes	Yes	No
California	(1969) under rev's	Yes	Yes	No
Colorado	(1968)	Yes	No (denatured)	No
Connecticut	(1970)	No	Monitor	No
Delaware	(1968)	Yes	Yes	Yes
Florida	(1966)	No	Yes	No
Georgia	(1971)	Yes	Yes	Yes
Hawaii				
Idaho	(1968)	Yes	No	No
Illinois	(1959)	Yes	Yes	No
Indiana	(1968)	Yes	Yes	No
Iowa	(1971) in prep.			
Kansas	In Prep.			
Kentucky	(1968)	Yes	Yes	No
Louisiana	(1968)	Yes	No	No
Maine				
Maryland	(1964)	Yes	No	No
Massachusetts	(1970)	Yes	May prohibit	No
Michigan	(1965) (1969)	Yes	Yes	Yes
Minnesota	(1969)	––	Yes	––
Mississippi	(1971)	Yes	––	––
Missouri	(1967)	Yes	No	No
Montana	(1966)	No	No	No
Nebraska	(1954)	Yes	No	No
Nevada	(Yes)	No	No	No
New Hampshire	(1971)	Yes	Yes	––
New Jersey	(1970)	Yes	Yes	Yes
New Mexico	(1967)	Yes	No	No
New York	(1964)	Yes	Yes	No
North Carolina	(1971)	Yes	Yes	No
North Dakota	(1970)	Yes	Yes	No
Ohio	(1970)	Yes	Yes	No
Oklahoma	(1970) in prep.	No	No	No
Oregon	(1960)	No	No	No
Pennsylvania	(1969)	Yes	Yes	No
Rhode Island	(Yes)	Yes	––	––
South Carolina	(1971)	Yes	No	No
South Dakota	(1952)	No	No	No
Tennessee	(1971)	Yes	Yes	No
Texas	(1970)	Yes	Yes	No
Vermont	(1969)	No	No	No
Virginia	(1971)	Yes	Yes	No
West Virginia				
Wisconsin				
Wyoming				
Utah				

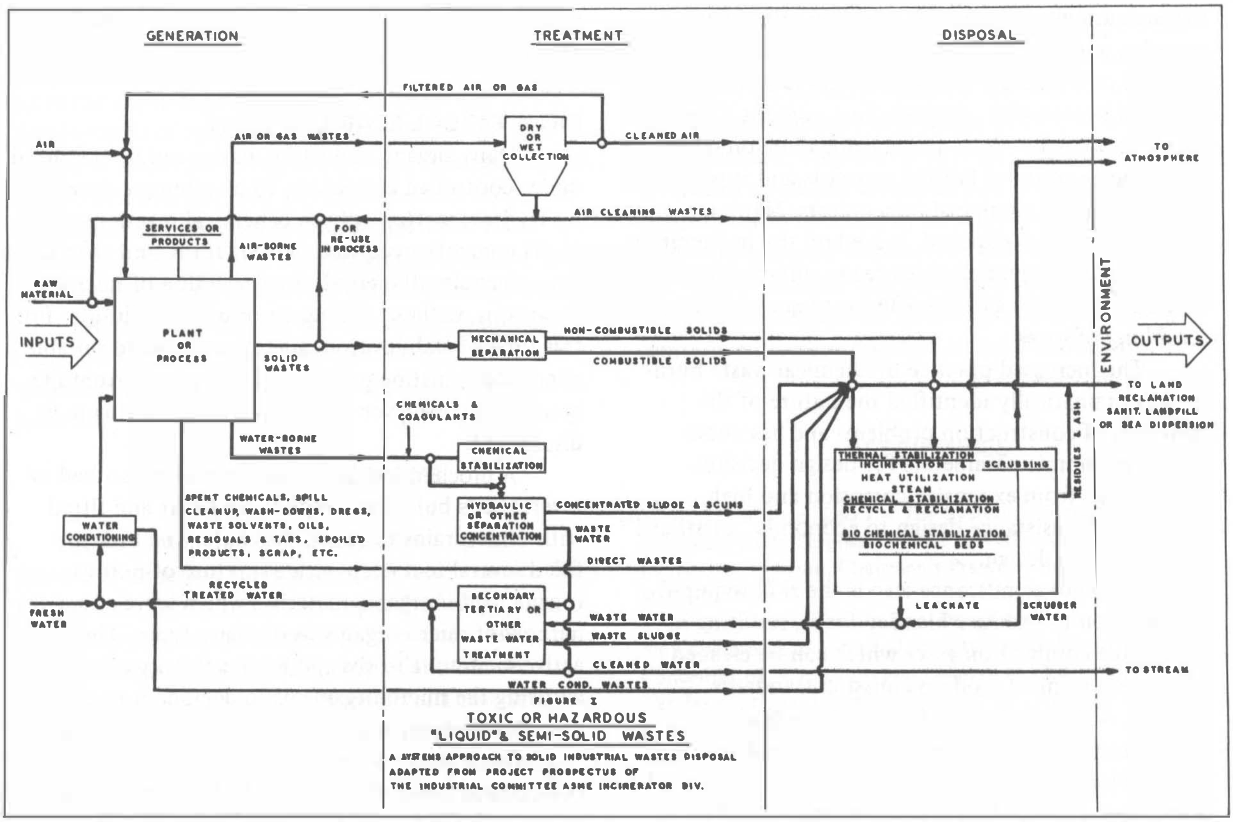

FIG. 1

groups: Waste Generation, Waste Treatment and Waste Disposal. In this discussion we are not concerned with how wastes are produced or how they are separated from the Media. Here we are concerned mainly with what to do about these concentrated waste materials.

CENTRALIZED DISPOSAL PLANTS

In highly industrial areas, there have recently been built several integrated centralized waste treatment plants to which these wastes are hauled for treatment and disposal. [2] The first of these has been operating over a year at the Logan Township, N.J., plant of Rollins-Purle, Inc. The second plant at Baton Rouge has been operating for about six months.

A second generation of integrated disposal plant for industrial wastes is presently being constructed in South Chicago; the first phases are now in operation. Collection and transport of wastes is by the established so-called "scavengers" and the operating permit requires that copies of all receipts be forwarded to the regulatory authorities. This requirement and the indemnity extended to the waste producer is a valued asset for the industrial clients.

Three basic techniques are employed in these plants:

Thermal Stabilization
Chemical Stabilization
Biochemical Stabilization

By proper use of these techniques, toxic and hazardous wastes of practically any type can be neutralized, stabilized and reduced in volume so that the residues may be safely deposited in sanitary landfill or used for land reclamation. Increasing recycling and in-plant control techniques will undoubtedly become technically feasible and economically justified in the future. While these will divert and reduce amounts of certain materials which may be pollutants, they will result in additional wastes perhaps of an even more difficult nature. As recovery techniques for metals, solvents and other materials become ecomically attractive, such techniques will be put into practice in these centralized plants.

THERMAL STABILIZATION

Industrial Waste Incineration Systems capable of burning nearly any industrial waste and of meeting the increasingly stringent air emission criteria are complex and costly. These systems are economically justified only in areas where there are large amounts of liquid wastes with adequate heat content. Considerable work has been and is being done on combined incineration of limited amounts and types of liquid wastes in municipal incinerators. Many more improvements are required, indeed on the incineration of conventional municipal wastes to obtain complete burnout, adequate gaseous afterburning and efficient scrubbing of gases.

The increased practice of chemical waste burning has dramatically identified the nature of the materials of construction problems and has necessitated economic parameters for design decision. These range from expensive corrosion and high temperature resistance design to economic "sacrificial" or expendable design.

Of major significance also is the skill required in operation to produce blended feeds, resulting in mangeable combustion gases which can be cleaned effectively to meet modern emission standards.

C. A. Hescheles has described the type of specialized incinerator used in these centralized disposal plants. [3] The 135 MKBTU/HR unit consists of a rotary kiln, a cyclonic burner, afterburner, and wet gas scrubber system. The second generation will include additional scrubbing and acidic gas neutralization to meet the increasingly stringent air quality regulations.

CHEMICAL STABILIZATION

Chemical stabilization includes such reactions as oxidation of cyanides, reduction of chromates, neutralization of alkali, acids and pickling liquors, and precipitation of metals as insoluble hydroxides. Coagulation, Flocculation, Absorption, Adsorption, Dewatering and other Physicochemical reactions can be conducted in such intergrated plants. These chemical operations are necessary to avoid ground or surface water pollution by soluble chemicals and they must be selected and conducted on the basis of effectiveness, economy and practicality.

Centralized treatment plants with storage facilities provide the opportunity for synergism and the use of one waste to treat another. Such techniques of effective waste treatment offer large savings in chemicals and are a very real method of "recycling" In a centralized plant, heat from an incinerator, otherwise wasted, can do useful work such as heating, drying, conditioning or activation of reactions. Operating advantages of this type of plant are the ability to provide greater skills in technique and operation, better equipment, greater safety, and more effective control and monitoring.

BIOCHEMICAL STABILIZATION

Many organic industrial wastes can be stabilized under controlled conditions by a technique developed by Hydronics. Here, physicochemical reactions such as pH control, precipitation, oxidation, and absorption take place simultaneously by the action of microorganisms, without risking air or water pollution. For this type of stabilization, adequate time and suitable conditions must be provided. The leachate from the system must be given further treatment if it is to be discharged.

A biochemical Stabilization system is a bed or several beds built with impervious liners and fitted with underdrains to collect leachate. The beds are filled several feet deep with a mixture of porous organic and inorganic materials which serve as a harbor for micro-organisms of many types. The active medium absorbs and retains the organic waste allowing the micro-organisms to degrade it to carbon dioxide, nitrogen and other innocuous end products.

Some water with soluble salts and organic compounds passes through the bed and is collected as leachate for further treatment. In passing through the beds, the nature of the waste liquid is changed in its chemical and biochemical characteristics. The actions of the Biochemical Beds are extremely complex because they include a variety of chemical, biological and physicochemical phenomena. Of particular significance is the fact that the organics in leachate are more readily bio-degradable after they leave the beds than when they enter. The leachate is further treated by appropriate means such as activated sludge, trickling filters, or lagoons to permit discharge or re-use.

The types of wastes which can be effectively treated by Biochemical Beds are carefully regulated dosages of any organic which is bio-degradable. This includes phenols, cyanides, alcohols, and polyols, cutting oils, water-oil emulsions and limited amounts of hydrocarbons, vegetable and animal oils. Large quantities of hydrocarbon oil sludges have been disposed of in small specialized land areas for many years. [4] Biological and other sludges can be stabilized and reduced in volume and many inorganic sludges can even be managed successfully. To accommodate the micro-organisms, wastes must be adjusted in pH and sometimes given other chemical pretreatment before dosing.

After the wastes have been stabilized, which may require as long as a year, the bed contents are suitable for useful purposes such as final cover in sanitary landfill and for land reclamation.

Design of these beds has evolved rather quickly from the crude beginning of several years ago to the development of relatively sophisticated design criteria. This new technique offers Solid Waste Management an economical and safe way to stabilize many industrial wastes and an opportunity to advance from the archaic practices of land-fill dumping. We believe this technique generally lends itself for use in conjunction with Sanitary land-fills for the stabilization of many organic liquid wastes in areas where large complex centralized treatment plants are not economically justified.

OPERATING PROBLEMS

Two problems of biochemical bed operation deserve comment. One is Winter operation in Northern Climates and the other is the disposal of salts.

The production of soluble salts from biochemical beds or indeed from any of these three stabilization techniques is unavoidable. These salts must ultimately go to the ocean unless they are injected underground. They get to the ocean by barging or flow down the rivers. Regulatory authorities are increasingly restrictive toward salt discharge in effluents, but there should be no objections to salt discharge during period of high stream flow.

Centralized plants with suitable incineration facilities can be used in a Systems Approach for the disposal of these soluble innocuous salts. The heat evolved from burning waste can be used for evaporation of salt solutions to produce a brine or to produce crystallized or evaporated salts for sale as road salts. In Winter operation incinerator heat in a centralized plant can also be used for tracing lines, for melting and heating liquid wastes. This heat is also useful for increasing chemical and biological activity, and demonstrates again the advantages of an integrated centralized facility disposal of industrial wastes.

REFERENCES

[1] Cohan, Leo J.– The Systems Approach to Industrial Waste Disposal; ASME Industrial Committee, Incinerator Division; Chairman's Presentation of Program; May 12, 1971.

[2] Burns, Robert B. – Design Problems and Operating Experiences of a Central Facility for the Disposal of Concentrated, Hazardous and Obnoxious Chemical Wastes; *The International Water Conference,* The Engineer's Society of Western Pennsylvania; October 1970.

[3] Hescheles, C. A. – *Proceedings 1970 International Incinerator Conference,* ASME, 255 Cincinnati, Ohio.

[4] Dotson, G. K., Dean, R. B., Kenner, B. A., and Cooke, W. G. – *Fifth International Water Pollution Res. Conf. and Exhibition;* San Francisco, Calif. July 26 – August 1, 1970