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Minnesota Mining and Manufacturing Company's Hazardous Waste Program

by Hugh J. Van Noordwyk, Jr.* and Michael A. Santoro*

This paper discusses the present hazardous waste program of 3M Company (Minnesota Mining and Manufacturing Company). 3M's definition of hazardous waste and the company's position on hazardous waste disposal are first considered. The company position is that wherever and whenever the disposal of a waste material threatens the environment or public safety, then that waste should be considered a hazardous waste and treated accordingly in terms of its handling and ultimate disposal. The generation of hazardous wastes and the differentiation of "hazardous" and "nonhazardous" wastes are described next. Handling of hazardous wastes from their generation to their disposal is then covered. This includes a definition of internal 3M terminology and a description of the hazard rating system used by the company. Finally, 3M disposal practices are presented. It is 3M's position that thermal destruction of hazardous wastes, where appropriate, is the best method for their disposal. With this in mind, 3M has constructed incineration facilities throughout the country. The rotary kiln incinerator at the 3M Chemolite plant in Cottage Grove, Minnesota is briefly described. Disposal of certain hazardous wastes in controlled secure land disposal sites is then briefly discussed.

Introduction

Prior to discussing hazardous waste generation and its handling and disposal within the operations that comprise 3M Company (Minnesota Mining and Manufacturing Company), it is necessary to recognize exactly how 3M defines hazardous waste. According to 3M's definition, hazardous waste is or can be any waste material that may present acute or chronic hazards that would harm the environment and/or affect public safety. Typical examples of hazardous waste that would fall within the scope of this definition include flammable solvents, toxic substances, oxidizing materials, etc. Generally, paper wastes, wastewater, and air contaminant emissions are not hazardous wastes by 3M's definition.

Considerable controversy now exists in both industry and government agencies on just how the term hazardous waste should be defined. Many criteria have been developed to "fine tune" the definition as to what may or may not be classified as a hazardous waste. This inexactness of definition has led to 3M's position that wherever and whenever the disposal of a waste threatens the environment or public safety, then that waste should be considered a "hazardous waste" and treated accordingly in terms of its handling and ultimate disposal.

Generation of Hazardous Wastes

With operations in most of the United States and many foreign countries, 3M generates hazardous waste which must be properly disposed. Proper disposal means avoiding acute or chronic hazards that would harm the environment and/or affect public safety. Hazardous wastes originating from 3M operations include such materials as dirty solvent from coating operations, mother liquors from chemical reactions, spent cleaning solutions reject products, nonmarketable experimental items, etc.

At the time a waste is generated, it is determined whether the waste is "nonhazardous" or "hazardous" (Fig. 1). This determination is made by weighing the potential negative effects of the waste on the environment and public safety if the waste is improperly disposed. The determination of hazardous waste generation, in this context, not only includes evaluation of waste from existing processes

* 3M Company, St. Paul, Minnesota 55133.

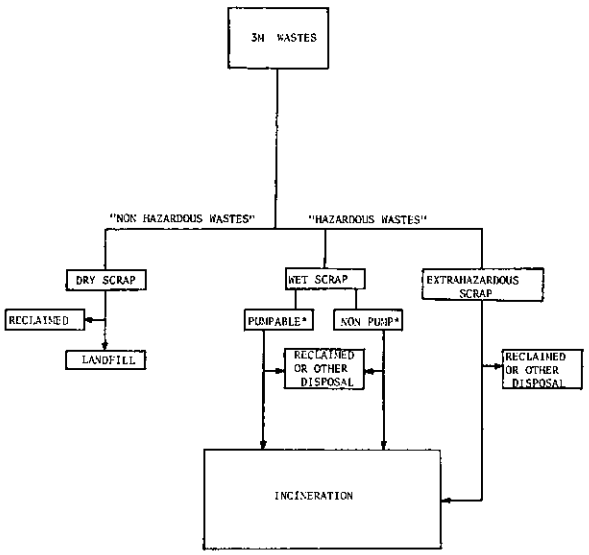

FIGURE 1. 3M Wastes differentiation. Pumpables and nonpumpables include both halogenated and nonhalogenated wastes. Chlorine is the primary halogen of concern.

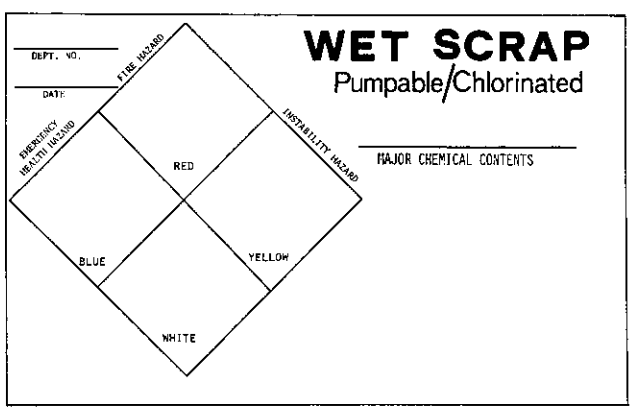

FIGURE 2. Wet scrap label.

or operations but also includes that from the laboratory of the researcher involved in the investigation of new product formulations, or from the pilot plant. Many times, at these points of product formulation or process development, an entire process has been delayed, and in some cases eliminated, due to the potential of producing a "hazardous waste" which would be unwieldy in its handling and/or disposal.

If a waste is determined to be "nonhazardous," it is usually landfilled in an environmentally safe, legal sanitary landfill. More and more nonhazardous wastes, such as polyester film, high quality paper, and corrugated cardboard are finding their way into reuse and reclamation programs with 3M. Nonhazardous wastes are termed dry scrap when discussed within 3M.

Internal Handling of 3M Hazardous Wastes

If a waste is determined to be hazardous, it then undergoes another determination, that is, whether the hazardous waste is a "wet scrap" or an "extrahazardous scrap" (Fig. 1). "Wet scrap" means that the waste is still hazardous but does not present enough hazard to be handled with the extra procedures accorded extrahazardous scrap. Wet scrap may be handled by personnel who are not as intimately knowledgeable of the hazards of wastes as would be the personnel who handle extrahazardous scrap. The packaging and labeling of the wet scrap suffices in protecting the involved personnel and gives them enough information to safely dispose of such waste. No additional information is deemed necessary to dispose of such waste. Figure 2 depicts a typical wet scrap label used for internal considerations involved in handling and disposing of wet scrap. This label provides personnel with an identification of the waste and associated hazards. Such labels are for internal use and not required by DOT (Department of Transportation) regulations, although the DOT "Flammable Liquid" label has been incorporated on some wet scrap labels to facilitate DOT labeling requirements in some instances. There is a series of sixteen wet scrap labels, the majority of which have preprinted hazard ratings (to be discussed later in this paper), used in the proper identification of and for information disclosure on wet scrap.

Extrahazardous scrap, in addition to meeting the packaging and labeling requirements for wet scrap, is always under the control and/or supervision of someone who is knowledgeable as to the hazards that the extrahazardous scrap presents. Special disposal procedures and requirements have been established beyond wet scrap considerations for this type of waste. Hazards which would qualify a waste as an extrahazardous scrap rather than a wet scrap could include mutagenic effects, extreme flammability, or explosive properties of the waste. Typical examples of extrahazardous scrap are carbon tetrachloride, ethylene oxide, and nitromethane. One special label, similar to the wet scrap labels, provides internal identification and information on such waste.

Breaking wet scrap down into more specific categories is accomplished by determining whether the wet scrap is pumpable or nonpumpable and

halogenated or nonhalogenated (chlorine being the primary halogen of concern) (Fig. 1) Pumpable wet scrap consists of homo- or heterogenous liquid solutions and mixtures. Nonpumpable wet scrap is made up of contaminated items such as used filter cartridges, gloves, aprons, off-spec products, etc., and also includes very viscous liquids.

Control of halogenated wastes is attempted by 3M to minimize corrosion effects on company incinerators and to minimize acid mists which result from the incineration of these wastes. Extrahazardous scrap has no such further breakdown (i.e., pumpable or nonpumpable, chlorinated or nonchlorinated) and is handled on a case-by-case basis.

Many of 3M's wet scrap streams and some extrahazardous scrap streams are now being reused or reclaimed. Since 1974, 3M has benefited by more than two million dollars as the result of hazardous waste recovery operations.

In addition to being designated as either wet scrap or extrahazardous scrap, 3M's hazardous wastes also receive hazard ratings (Fig. 2) to aid in their handling and disposal. These ratings are helpful should an emergency situation arise that requires quick action. They quite frequently are used, however, for considerations of a long-term nature, as might be the case with environmental or public safety considerations. Hazard ratings assigned to a hazardous waste are for emergency health, fire, and instability considerations. These ratings are marked on a four-color diamond (blue, red, yellow, and white, respectively, for the above considerations) on either the wet scrap (Fig. 2) or extrahazardous scrap labels. The ratings range from zero (0), the least severe, to four (4), the most severe, depending on the emergency considerations for that scrap (see Table 1 for explanation of hazard ratings). The white portion of the four-color diamond is reserved for special considerations of the waste: water reactivity, designated by the symbol W, and polymerizability, designated by the symbol P.

Generally speaking, waste having a composite rating of greater than 2-3-0 (health, fire, instability, respectively) is considered to be extrahazardous scrap requiring special handling and disposal. "Dry scrap" includes waste having a composite rating of less than 1-2-0. Between the composite ratings for dry scrap and extrahazardous scrap, waste is classified as wet scrap.

In addition to its own internal labeling system, 3M meets DOT requirements for labeling, marking, and packaging hazardous wastes as part of the company's hazardous waste program.

Disposal of Hazardous Wastes

Wet scrap and extrahazardous scrap are normally disposed of by 3M via incineration. 3M operates seven incinerators throughout the country for the disposal of its own hazardous wastes. These incinerators are located on 3M manufacturing plant sites at Brownwood, Texas; Cordova, Illinois; Cottage Grove, Minnesota; Decatur, Alabama; Hartford City, Indiana; Nevada, Missouri; and White City, Oregon. These incinerators range from simple one-chamber stationary incinerators to a sophisticated rotary kiln incinerator located at 3M's Chemolite plant in Cottage Grove, Minnesota. 3M believes that thermal destruction of hazardous wastes, when appropriate, is the most environmentally sound method of disposal, presents the fewest and shortest-lived environmental problems,

Table 1. 3M hazard ratings.[a]

Class	Rating	Definition
Health[b]	4	Extreme hazard: do not enter vapor or liquid
	3	Severe hazard: use special protective clothing
	2	Hazardous: use self-contained mask or special ventilation
	1	Irritating
	0	Like ordinary material
Fire	4	Extremely dangerous fire and explosion hazard
	3	Fire and explosion hazard at normal temperatures
	2	Must be preheated above 100°F to burn
	1	Must be preheated above 200°F to burn
	0	Will not burn
Instability	4	Extreme explosion hazard: Vacate area if materials are exposed to fire
	3	Severe explosion hazard
	2	Violent chemical change possible
	1	Unstable if heated
	0	Normally stable

[a] From 3M Safety Memo 138, Safety Engineering Department, 1969.
[b] Health hazard refers only to concentrated contact or inhalation for a short time.

if any, and eliminates most hazards associated with such wastes.

The six smaller incinerators, other than the Chemolite incinerator, were designed principally for the disposal of pumpable hazardous wastes. However, incorporation of special equipment or procedures has resulted in the ability of half of these small incinerators to destroy solid hazardous waste, wet scrap and extrahazardous scrap alike.

The 3M Chemolite incinerator is, as previously mentioned, a rotary kiln incinerator with a design heat load of 90 million BTU/hr (26 MW) (Fig. 3). This heat load is divided between the rotary kiln portion (the primary combustion chamber) and the secondary combustion chamber at a ratio of 2:1 or 60 million BTU/hr (18 MW) and 30 million BTU/hr (9 MW), respectively. The average baseline operating temperatures are 1100°F (590°C) in the primary chamber and 1600°F (870°C) in the secondary chamber. Both chambers are refractory lined. Total retention time in the thermal environment of the incinerator, which includes the primary and secondary chambers and a mixing chamber between the combustion chambers, is up to three seconds depending on the combustion air flow. The mixing chamber assures more effective combustion by mixing the gases prior to their entry into the secondary chamber. Resultant inorganic ashes and those metal drums which are dropped through the feed chute into the rotary kiln are collected at the end of the kiln by means of a continuous ash removal system.

Air pollution control equipment following the secondary combustion chamber insures that the incinerator's emissions comply with the Minnesota Pollution Control Agency's limit of 0.1 grain of particulate matter per dry standard cubic foot (0.2 g/m^3), corrected to 12% carbon dioxide. The air pollution control equipment consists of a quench elbow, quench chamber, Venturi scrubber, and a mist eliminator. The resultant gases following the air pollution control equipment are then pulled through a 500 horsepower (370 kW) induction fan, forced up a 200-ft (60 m) stack, and exit to the atmosphere.

Although the majority of 3M's hazardous wastes are disposed of by incineration, some of them go to controlled secure land disposal sites. These are primarily hazardous wastes which are not amenable to disposal by incineration due either to their inherent chemical or physical properties. Those hazardous wastes not incinerated, but land disposed, because of their chemical or physical nature, involve for the most part those wastes which consist partly of heavy metal compounds.

Summary

3M has developed a systematic and logical procedure for dealing with its hazardous wastes from the point of generation to their ultimate disposition. The first step is recognizing hazardous wastes from nonhazardous wastes. 3M has implemented criteria and guidelines to do this. 3M's handling of hazardous wastes is further enhanced by the differentiation of such wastes into wet scrap and extrahazardous scrap categories. Additionally, the hazard rating system employed by 3M enables the emergency considerations of the wastes to be immediately available during handling and disposal operations.

3M's position that thermal destruction of hazardous waste, where appropriate, is the best method for the disposal of hazardous wastes points out the

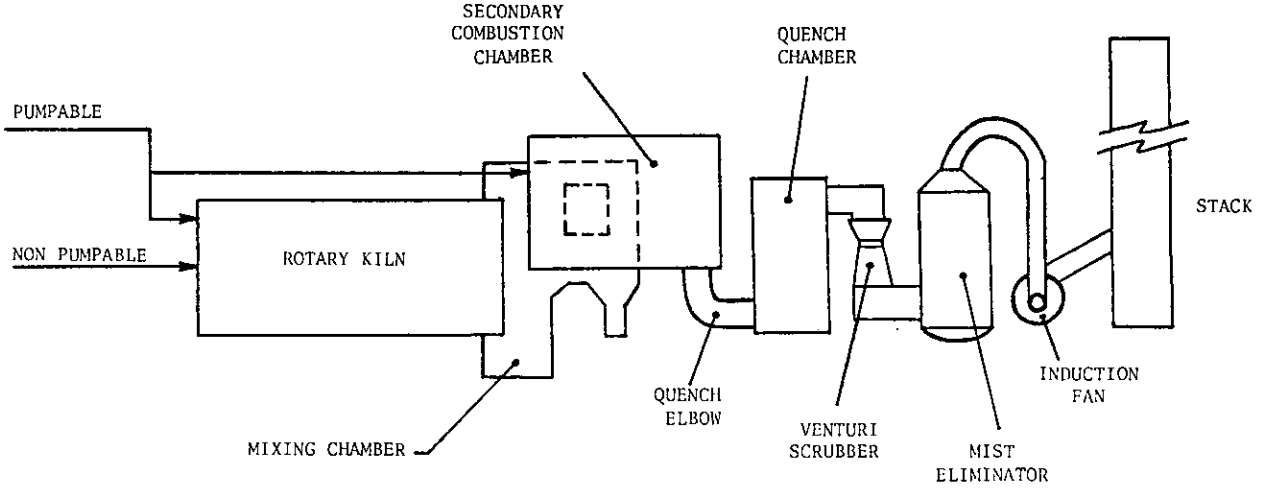

FIGURE 3. Chemolite incinerator schematic.

company's concern for proper hazardous waste disposal. 3M believes that complete thermal destruction eliminates most environmental and public safety problems associated with the disposition of this type of waste. Disposal of hazardous wastes in controlled, secure, land disposal sites, when incineration is not feasible, is practiced by 3M only after thorough investigation of the site to be used and determination of the compatibility of the hazardous waste with the site. It is 3M's opinion that in the future more and more hazardous wastes will be directly reused or reclaimed for reuse.