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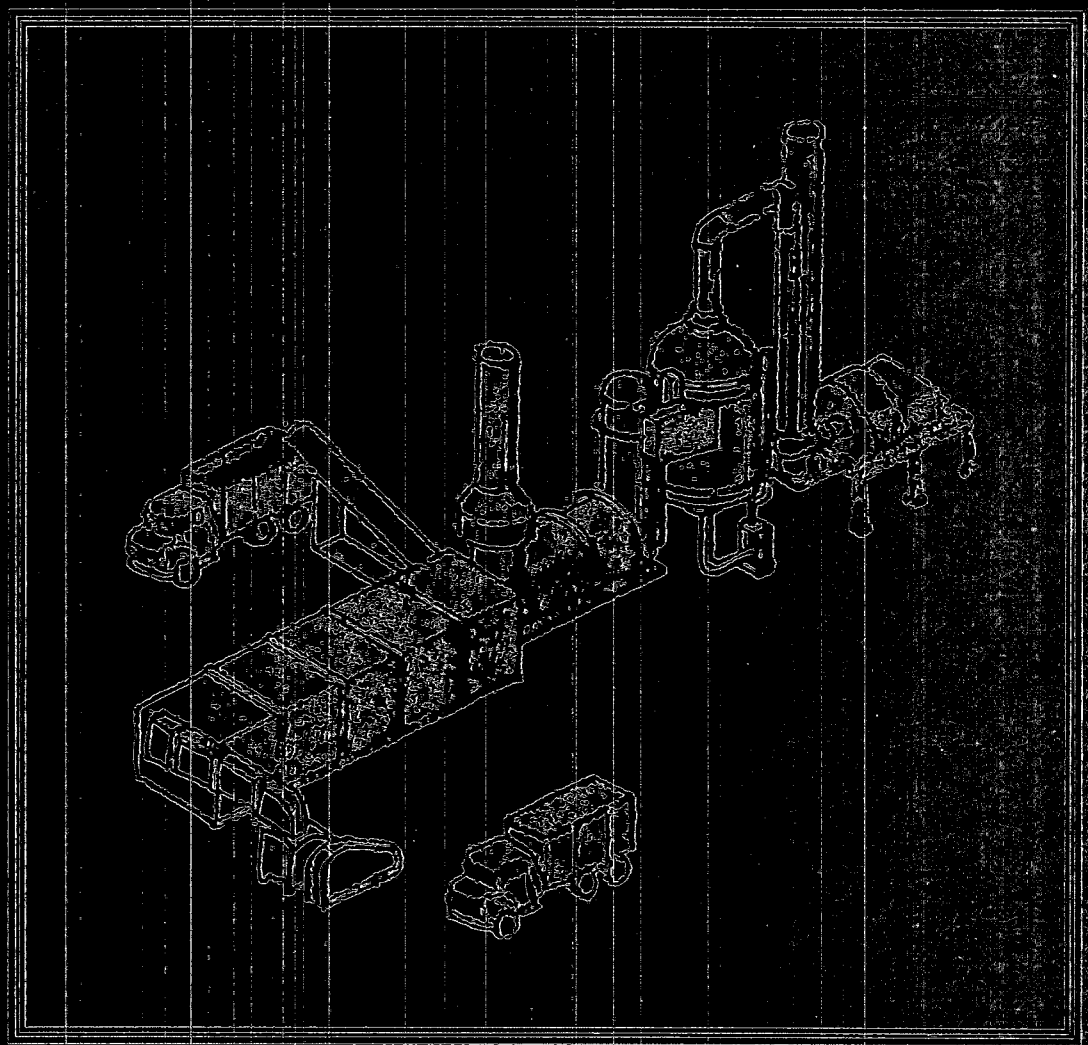
Hazardous Waste Incineration: Questions and Answers



HAZARDOUS WASTE INCINERATION: QUESTIONS AND ANSWERS

Prepared for

Office of Solid Waste
U.S. Environmental Protection Agency

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TABLE OF CONTENTS

INTRODUCTION

This booklet provides answers to questions that citizens may have about hazardous waste incineration. Many cities and towns operate incinerators that burn non-hazardous wastes, such as household garbage. Incinerators are also used to burn **hazardous wastes**.* Most hazardous wastes are byproducts of a broad spectrum of industrial and manufacturing processes; other hazardous wastes result from other activities, for example, the removal of contaminated soil from a **Superfund** site or a chemical spill. When managed improperly, hazardous wastes can pollute the environment, causing harm to people, animals, and plants. Incineration detoxifies hazardous wastes by destroying many of the harmful components of the wastes. Based on the results of research on incineration, EPA has concluded that incineration is the best method currently available for treating certain types of hazardous wastes.

Why is hazardous waste incineration important?

EPA expects that increased use of hazardous waste incineration will help avoid the environmental problems caused by mismanagement of hazardous waste. EPA studies and independently prepared reports have concluded that hazardous waste incineration is safe and is preferable in many cases to the primary competing technology, disposal of wastes on land. In the Hazardous and Solid Waste Amendments (**HSWA**) of 1984, Congress mandated a ban on the land disposal of untreated hazardous wastes. EPA believes that incineration will play a major role in providing a treatment alternative to land disposal.

Incineration's main advantage is that it permanently destroys some of the toxic qualities of the waste. A report by the Congressional Office of Technology Assessment (OTA) concluded that hazardous waste incineration is safer than land disposal. The report stated that "it is preferable to permanently reduce risks to human health and the environment by waste treatments that destroy or permanently reduce the hazardous character of the material, than to rely on long-term containment in land-based disposal structures."

Incineration has been used in the U.S. and Europe to treat hazardous wastes for many years. As of 1987, there were over 200 hazardous waste incinerators operating in the U.S. Most of these incinerators are used by companies for their own wastes; the remainder incinerate wastes for payment. Today, incineration is also playing an important role in the cleanup of many Superfund sites, where it is used for treating contaminated soils and other wastes removed from the site. In recent regulations that set treatment standards for hazardous wastes that are to be disposed on land, EPA has

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* Words defined in the glossary at the end of the booklet are marked in bold at their first appearance.

identified incineration as the **Best Demonstrated Available Technology** (that is, the commercially developed technology that provides the most effective treatment) for certain types of wastes.

EPA believes that greater quantities of hazardous wastes will be treated using incinerators in the coming years. As demand for incineration increases, EPA expects to receive applications for permits from businesses wishing to build and operate new incinerators. In addition, Congress, in the Hazardous and Solid Waste Amendments of 1984 (HSWA), gave EPA a deadline of November 8, 1989 for final decisions on permit applications for hazardous waste incinerators that were submitted to EPA by November 8, 1984. Incineration will therefore be more in the public eye, and will be the object of more interest and questions from citizens.

What information can be found in this booklet?

The focus of this booklet is hazardous waste incineration and its regulation under the Resource Conservation and Recovery Act (**RCRA**). Because hazardous waste is a legal term, wastes must meet specific criteria to be regulated as hazardous under RCRA. Certain wastes that have dangerous properties, for example, radioactive wastes and polychlorinated biphenyls (**PCBs**), are not included in the legal definition of hazardous waste. Management of radioactive wastes is regulated by the Nuclear Regulatory Commission and the Department of Energy; management of PCBs is regulated by EPA under the Toxic Substances Control Act (**TSCA**).

EPA's regulatory program for PCB incineration is based on a similar framework of standards, permits, and enforcement, although there are some differences in specific procedures and requirements. This booklet does not provide information on this program. For more information on incineration of PCBs, contact your EPA regional office (see page 44).

This booklet is organized into six chapters. The first chapter answers questions about the technical aspects of hazardous waste incineration. Chapter 2 provides a general description of EPA's program for regulating hazardous waste incinerators and describes the federal performance standards for hazardous waste incinerators. Chapter 3 explains the process of developing and issuing permits, while Chapter 4 describes how permit conditions are enforced. Chapter 5 describes general standards that apply to owners and operators of all hazardous waste treatment, storage, or disposal facilities. The last chapter, Chapter 6, explains the potential risks involved in hazardous waste incineration.

CHAPTER 1

HAZARDOUS WASTE INCINERATION: A TECHNICAL OVERVIEW

This chapter describes technical aspects of hazardous waste incineration, including the following:

- Overview of the incineration process;
- Types of wastes suitable for incineration;
- Descriptions of several of the more common types of hazardous waste incinerators;
- Descriptions of common types of air pollution control devices used on hazardous waste incinerators;
- Maintenance requirements for incineration units; and
- Alternatives to incineration;

The chemical reactions that occur during incineration are extremely complex. The intent of this chapter is to describe this complex process in general terms to provide a basic understanding. The variety of incinerator designs and air pollution control equipment, however, precludes a complete and detailed discussion of incineration technology. Only the most commonly used designs and equipment are discussed.

BASIC PRINCIPLES OF INCINERATION

What is incineration?

Incineration is the burning of substances by controlled flame in an enclosed area (compartment). This process (1) detoxifies hazardous wastes by destroying **organic compounds** contained in the wastes, (2) reduces the volume of the wastes, and (3) converts wastes to solids by vaporizing water and other liquids the wastes may contain. Organic compounds (compounds composed of carbon, hydrogen, and sometimes other elements) burn over a broad range of temperatures. Wood, oil, and coal, for example, are all composed of organic compounds that burn at relatively low temperatures. Some organic compounds, including some found in certain hazardous wastes, burn less readily and must be subjected to higher temperatures before they burn. A hotter fire also burns more completely than a cooler one. As a consequence, hazardous waste incinerators must maintain extremely high temperatures (typically ranging from 1800°F to 2500°F) to ensure that virtually all organic compounds in the wastes are destroyed. Although

incineration does not destroy **inorganic compounds** (carbonless compounds, such as salts or metals, and carbon compounds lacking hydrogen, such as carbon monoxide and carbon dioxide), it can be used for wastes that contain them in order to prepare the inorganic materials for easier management and handling. Incineration is more effective, however, in reducing the hazardous properties of wastes that are mainly composed of organic compounds.

How does an incinerator work?

Incineration involves four basic steps:

- Wastes are fed into the incinerator;
- Wastes are burned, destroying organic compounds and yielding residual products in the form of ash and gases;
- Ash is collected, cooled, and removed from the incinerator; and
- Gases are cooled, cleaned, and released to the atmosphere through the incinerator stack (or chimney).

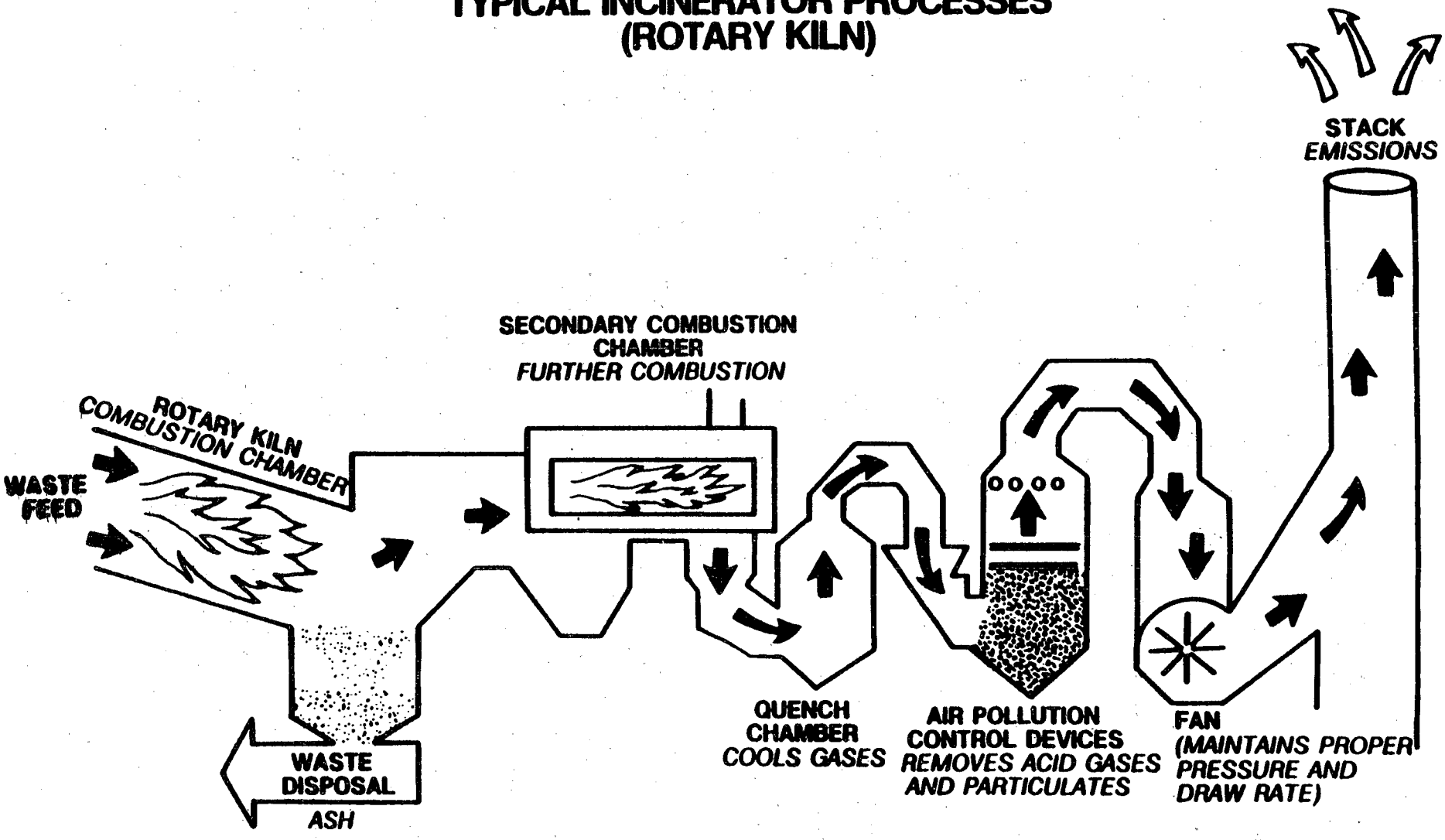
The specific equipment used for each step depends on the incinerator type and the physical and chemical characteristics of the wastes the incinerator is designed to burn. In addition, steps may be added at various points to improve efficiency. For example, in some systems, wastes are preheated or ignited before they enter the parts of the incinerator where the highest temperatures are maintained. The picture (see next page) shows a typical rotary kiln system, one that could be used for incineration of a wide variety of wastes.

How are wastes burned in the incinerator?

During a burn (a period during which the incinerator is in operation), wastes are fed into the incinerator in batches or in a continuous stream. Whether continuous or batch, this flow of wastes is generally referred to as the **waste feed.** Feed mechanisms are diverse: liquid wastes are often pumped into incinerators through a nozzle, a device that breaks up the liquid into fine droplets that burn more easily. Solid wastes may be fed into the incinerator in bulk or in containers using a conveyer or a gravity system.

Wastes are burned in the **combustion chamber**, a furnace-like area that contains a burner and which is designed to withstand and maintain extremely high temperatures. As the wastes are heated, they are converted from solids or liquids into gases. The gases are mixed with air and passed through the extremely hot flame. As the temperature of the gases rises, the organic compounds in the gases begin to break down into atoms. These atoms recombine with the oxygen from the air to form stable inorganic compounds,

TYPICAL INCINERATOR PROCESSES (ROTARY KILN)



such as carbon dioxide and water. Depending on waste composition, other inorganic compounds (for example, acid gases such as hydrogen chloride) may form. This entire process is called **combustion**.

Temperatures in combustion chambers vary, but are generally in the range of 1,800°F to 2,500°F, temperatures well above those required to break down the more difficult-to-burn organic compounds. Wastes are generally maintained at these elevated temperatures from less than one second to several seconds. In many incinerators, combustion occurs in two combustion chambers. Combustion of more easily burned organics is completed in the first chamber. For compounds that are difficult to burn, combustion is completed in the **secondary combustion chamber** after the compounds have been converted to gases and partially combusted in the first chamber.

What is the composition of residuals from the combustion process?

Combustion yields two residual products: solids, in the form of ash, and gases. Combustion gases are composed primarily of carbon dioxide and water, plus small quantities of carbon monoxide, nitrogen oxides, and other gases that depend on the composition of the waste burned. Ash is an **inert** inorganic material made up of carbon, salts, and metals. The exact composition, like that of the gases, depends on the waste burned. During combustion, most ash collects at the bottom of the combustion chamber; some ash, however, is carried along with the gases as small particles, or **particulate matter**. Different types of wastes yield different quantities of ash. Incineration of liquids generally produces very small quantities of ash relative to the quantity of waste burned. Incineration of solid wastes yields greater quantities of ash: typically, from 10 to 30 percent of the original waste quantity. Ash is removed from the bottom of the combustion chamber and, by regulation, is considered a hazardous waste (as are all residuals from hazardous waste treatment processes, whether or not the residuals exhibit the characteristics of hazardous wastes). If the owner or operator can prove that the ash is not hazardous, however, EPA issues an exemption called a "**delisting.**"

How are combustion gases cooled and cleaned before release?

Following combustion, the combustion gases move through various devices that cool and cleanse the gases before the gases are released to the atmosphere through the incinerator stack. A fan is typically used to maintain the flow of gases through the system. One common cooling system is a **quench chamber**, where gases are cooled by direct mixing with water. **Air pollution control devices** are used to remove both particulate matter and acid gases from the combustion gases. The exact number and types of devices used will depend on the incinerator and the types of waste it burns. For example, hydrogen chloride is created by combustion of wastes containing chlorinated organic compounds. RCRA standards limit the amount of hydrogen chloride that can be released through the emission of combustion gases. If an incinerator is not used for burning chlorinated organic wastes, it will not require a special device for hydrogen chloride removal.

Does incineration destroy all organics in the waste?

A well-designed hazardous waste incinerator that is properly operated will destroy all but a tiny fraction of the organic compounds contained in the waste. Such incinerators perform at levels extremely close to complete combustion (that is, the total destruction of all organic compounds), and new technology is being developed that will improve upon current levels of performance. Complete combustion is only a theoretical concept, however, since the development of a 100 percent efficient incinerator is not possible.

The three critical factors that determine the completeness of combustion in an incinerator are (1) the temperature in the combustion chamber; (2) the length of time wastes are maintained at high temperatures; and (3) the turbulence, or degree of mixing, of the wastes and the air (an important determinant of the availability of oxygen during burning). To ensure that these factors are working together to promote virtually complete combustion, a RCRA permit for a hazardous waste incinerator specifies allowable ranges for and requires continuous monitoring of certain critical parameters. Among these parameters, or **operating conditions**, are maximum allowable carbon monoxide levels in emissions, allowable ranges for temperature, and maximum waste feed rates.

What is contained in the gases emitted from the incinerator?

Incinerator emission gases are composed primarily of two harmless inorganic compounds, carbon dioxide and water. The type and quantity of other compounds depends on the composition of the wastes, the completeness of the combustion process, and the air pollution control equipment with which the incinerator is equipped. These compounds include organic and inorganic compounds contained in the original waste and organic and inorganic compounds created during combustion:

- Organic compounds from the original waste. A well designed incinerator, when operated properly, is highly efficient, and will burn all but a very small quantity of the organics in the waste. The organics that do not combust are carried along in the gases leaving the combustion chamber. As the gaseous, uncombusted organics move through the remainder of the incinerator, some are removed by air pollution control equipment. RCRA standards set a limit on emissions of designated organic compounds.

- Inorganic compounds from the original waste. Inorganic compounds, such as salts and metals, do not combust. These compounds end up either in the bottom of the combustion chamber in the ash or carried along with the combustion gases,

depending primarily upon their weight. These inorganic compounds generally are contained in or adhere to particulate matter. RCRA standards limit the quantity of particulate matter that may be emitted from the incinerator. Air pollution control devices are therefore used to remove most particulate matter and adhering materials from the combustion gases.

- Organic compounds not present in the original waste. Because combustion in an incinerator is not 100 percent efficient, very small quantities of "new" organic compounds may form from the breakdown and recombination of the original compounds. These compounds are called "products of incomplete combustion" (or **PICs**) and are formed during the combustion of any organic material. For example, PICs are formed when wood is burned in wood stoves, or when gasoline is burned in an automobile engine. The combustion process may create small quantities of many different types of PICs and some fraction of these compounds may be hazardous. Among the types of compounds found in various analyses of PICs are some that are considered toxic, including dioxins and dibenzofurans. In a state-of-the-art incinerator, PIC formation is minimized by keeping the initial products of combustion at high temperatures for an appropriate length of time. PICs are destroyed by the high temperatures maintained in the combustion zone or a secondary combustion chamber. Air pollution control devices also remove PICs.

- Inorganic compounds not present in the original waste. In addition to carbon dioxide and water, combustion always produces small quantities of carbon monoxide and nitrogen oxides (from the combination of oxygen and nitrogen in the air). Combustion of complex organic compounds (including many hazardous wastes) may create other inorganic compounds, depending on what is being burned. Many hazardous wastes contain chlorinated organic compounds, sulfur, or organically-bound nitrogen. Combustion of these compounds yields hydrogen chloride, oxides of sulphur, and oxides of nitrogen, respectively. Carbon monoxide, as well as nitrogen and sulfur oxides, are typically found in auto emissions and emissions from other combustion facilities, such as coal-burning power plants. Because it

is more uniquely associated with the burning of hazardous wastes, RCRA standards place limitations on emissions of hydrogen chloride.

What types of wastes are incinerated?

Incinerators can be designed to accept wastes of any physical form, including gases, liquids, solids, **sludges** (thick, heavy mixtures of liquids and solids), and **slurries** (thin mixtures of liquids and solids). Although any waste can be incinerated, incineration is primarily for the treatment of wastes that contain organic compounds. Wastes with a wide range of chemical and physical characteristics are suitable for incineration. Most of these wastes are byproducts of industrial manufacturing and chemical production processes or result from the clean-up of contaminated sites.

INCINERATION TECHNOLOGY

Are there different types of hazardous waste incinerators?

The two most common types of hazardous waste incinerators are rotary kiln and liquid injection. Other types exist, some of which are becoming more widely used; others are still in the developmental stage. Choice of a particular type of incinerator design is determined primarily by the types of wastes to be treated.

Rotary kiln incinerators are versatile units that can accept gases, liquids, sludges, slurries, and solids either separately or simultaneously, either in bulk or in containers. Because of this versatility, rotary kilns are commonly used to treat a variety of wastes. The kiln is a cylindrical shell mounted on its side at a slight angle to the horizontal. As the kiln rotates and the wastes travel down the slope, the organic chemicals in the waste convert into gases and partially combust. The gases then pass into another combustion chamber (called an **afterburner** or the secondary combustion chamber) where more complete combustion is achieved. Ash residue is removed from the lower end of the kiln.

Liquid injection incinerators are capable of accepting gases, liquids, and slurries. The heart of the liquid injection incinerator is a nozzle or some other device that "atomizes" the liquid stream. Pumped at high pressure through the atomizer, the liquids emerge as tiny droplets that mix well with air and auxiliary fuel and easily convert into gases. Liquid injection systems are often designed for specific wastes. Consequently, the design of the atomizing device limits the types of wastes that a particular incinerator can treat. In spite of this disadvantage, liquid injection systems are widely used where versatility is not a primary requirement, or as an adjunct to a more flexible unit, such as the rotary kiln.

Mobile incineration systems have been constructed using various designs. These systems are hauled to a site on flat-bed trucks, then assembled and tested. Mobile incinerators are usually smaller than stationary facilities, but they operate on identical principles. Incinerators may also be mounted on ships.

Among the many types of hazardous waste incinerators, one of the more common types is the fluidized bed. **Fluidized bed incinerators** burn finely divided solids, sludges, slurries, and liquids. The bed consists of an inert granular material, usually sand, that is suspended by pressurized air in a highly turbulent, or fluidized state above the combustion chamber floor. Waste is conveyed into the fluidized bed where direct contact with the bed material improves the transfer of heat. Combustion gases move out of the combustion chamber for cooling and further treatment. Ash caught in the bed material is eventually removed when the bed material is replaced.

What types of pollution control devices are used on hazardous waste incinerators?

Combustion gases are typically treated to remove inorganic acid gases and particulate matter. Particulate matter (and adhering metals) can be removed with several devices. One of the oldest methods is **baghouse filtration** which involves passing the gas through a material (usually fabric) that collects the particulate matter. Another method involves **electrostatic precipitators**; the particulate matter is electrically charged and collects on plates that are oppositely charged. The particulate matter is then periodically cleaned from the plates. Still another approach is the venturi scrubber. **Venturi scrubbers** use high-pressure water to remove the particulate matter.

Hydrogen chloride gas is typically removed using other types of scrubber devices. Some examples are **packed bed**, **spray tower**, and **plate tower scrubbers**. These scrubbers bring alkaline water and the combustion gases together, providing the greatest possible contact between the water and the gases. The water is broken up into fine droplets and sprayed into the gas or the gas is broken up into small bubbles and flows up through the water. This allows hydrogen chloride, an acid gas, to dissolve in and be neutralized by the alkaline water. Also available are dry scrubbers which use either dry scrubbing material or an alkaline slurry which is dried when it is injected in to the hot combustion gases. Venturi scrubbers are not generally used for hydrogen chloride removal; however, the use of alkaline water in a venturi scrubber will remove some hydrogen chloride, in addition to removing particulate matter.

Many air pollution control devices use water, thus creating wastewaters containing the pollutants that have been removed from the gases. The Clean Water Act sets requirements for wastewater discharges, placing limits on temperature, pH (a measure of acidity or alkalinity), quantity of suspended solids, and pollutant levels. Any wastewaters from the incinerator not meeting these requirements must be treated before being disposed or released to a river, stream, or sewer system. Possible treatments include settling, metals precipitation, and neutralization.

What maintenance does an incinerator require?

Equipment maintenance varies greatly depending upon the type of equipment, its materials of construction, and the chemical and physical stresses to which the equipment is subjected. For example, the heat-resistant lining in the combustion chamber normally lasts two to three years, but incineration of wastes

containing alkali metals may require the lining to be replaced every four months. To ensure that the incinerator functions properly throughout its lifetime, RCRA permits require that the owner or operator of the facility perform regular inspections and maintenance according to schedules included in the permit (Chapter 5 provides more information on these requirements). In addition, the regulations require that an incinerator maintain the same operating conditions (such as temperature) that it did when it was tested. The incinerator must be maintained properly in order to achieve the operating conditions. EPA (or the responsible state agency) also conducts periodic inspections and may review maintenance records and other data to ensure that the incinerator continues to operate well. Furthermore, the permit is effective for no more than ten years, less than the potential life of the incinerator. Thus, the performance and operating condition of older incinerators are scrutinized when permits come up for renewal.

ALTERNATIVES TO INCINERATION

How does incineration compare to land disposal?

Incineration, since it is a method of treatment rather than disposal, has several advantages over land disposal methods. Incineration breaks down organic compounds, permanently eliminating environmental hazards posed by them. Land disposal only controls the hazard as long as the wastes remain contained in the disposal unit. The very small amounts of hazardous compounds released during incineration are released in a slow, controlled manner so that they do not pose any threat to nearby residents or the surrounding environment. Although incinerator ash requires disposal in a landfill, the process of incineration greatly reduces the volume of the material to be disposed. This is extremely valuable, given that space in landfills is becoming increasingly scarce. In addition, ash consists mostly of inert material, whereas organic compounds may react with other compounds in the landfill to form acids that hasten deterioration of liners that contain the wastes in the landfill.

Today, the principal disadvantage of incineration compared to land disposal is that of cost. However, as the land disposal restrictions instituted by HSWA begin to go into effect, the land disposal alternative will become more costly since producers of hazardous wastes will have to treat wastes before they can be disposed on land. Land disposal costs will also increase over the coming years because of changes in RCRA requirements. Thus, the cost difference between incineration and land disposal will disappear for some wastes and become less important for others. For many types of hazardous wastes, incineration will become the least expensive treatment alternative.

Rather than building incinerators to treat their hazardous waste, why don't companies change their production processes so that these wastes are not produced?

Waste minimization, that is, steps that eliminate or reduce the production of hazardous wastes, is becoming increasingly important as society deals with the problem of hazardous waste. EPA encourages waste minimization, and is assisting companies in determining how waste minimization techniques can be

applied to their processes. The move towards waste minimization is a gradual process, however, and it is likely to take many years before hazardous waste volumes are significantly reduced. In addition, waste minimization techniques will not totally eliminate the need for treatment and disposal technologies. Incineration should therefore remain an important technology for treating hazardous wastes, even as less waste is produced.

Are there any other alternatives to incineration?

Many new types of **thermal treatment** technologies are currently being studied. Incineration is one type of thermal treatment that uses combustion (burning) in the presence of oxygen to destroy hazardous compounds. Other thermal treatments use hot fluids or other materials with elevated temperatures to treat wastes. At this time, most of these technologies are probably too new to be considered commercially available alternatives to incineration, but they may play an increasingly significant role in the future. These new technologies include **pyrolysis**, **molten salt reactors**, reaction in **supercritical water**, and **plasma-arc reactors**. Of these technologies, only pyrolysis is commercially available now. The others are in the developmental stages.

For some types of liquid organic wastes, biological or chemical treatment is an economical and effective alternative to incineration. **Biological treatment** breaks down organic wastes using microorganisms that consume the organics. Although these systems cannot presently tolerate very toxic wastes or wastes containing more than small amounts of inorganics, future biotreatment systems may be developed which can treat a greater variety of wastes. Several forms of **chemical treatment** can be used to recover valuable materials in the wastes, such as solvents. Some processes that allow solvent recovery are distillation, steam stripping, and solvent extraction. These processes may be preferable to incineration if the chemicals contained in the waste are expensive to produce or if the waste is only slightly contaminated. Other forms of chemical treatment (for example, lime precipitation) are more effective than incineration for wastes containing large quantities of metals or wastes composed mostly of inorganic chemicals.

Based on current data, EPA believes that incineration is the best technology available for the treatment of many organic wastes. Although there are still some areas of technical and scientific uncertainty concerning incinerator emissions, incineration is preferable to alternative technologies such as land disposal because it reduces both waste toxicity and volume.

CHAPTER 2

THE REGULATORY PROGRAM FOR HAZARDOUS WASTE INCINERATORS

The treatment, storage, and disposal of hazardous wastes, including land-based incineration of hazardous wastes, is regulated under Subtitle C of The Resource Conservation and Recovery Act (RCRA). RCRA was passed by Congress in 1976 and amended by the Hazardous and Solid Waste Amendments (HSWA) in 1984. Under RCRA, EPA is required to set standards for the management of hazardous waste from "cradle to grave," from the time the waste is first produced until it is treated or disposed. RCRA provides EPA with the authority to develop standards for producers and transporters of hazardous wastes and facilities that treat, store, or dispose of hazardous waste. RCRA requires that these standards be sufficiently stringent to protect human health and the environment.

Who regulates hazardous waste incinerators?

RCRA gives states the option of developing and administering their own hazardous waste programs in place of the federal program that EPA administers. EPA must approve a state's program before it can take the place of EPA's program. To gain approval, a state program must be consistent with and equivalent to the federal RCRA program, and at least as stringent. State programs may be more stringent or extensive than the federal program. For example, a state may adopt a broader definition of hazardous waste in its regulations, designating certain wastes hazardous that are not hazardous under the federal regulations. This booklet describes the federal RCRA program, the minimum requirements applicable throughout the country. These regulations are contained in Parts 260-271 of Volume 40 of the **Code of Federal Regulations**. Volume 40, Part 264 of the Code of Federal Regulations contains standards for permitted hazardous waste facilities; Subpart O of Part 264 gives the specific standards for incinerators. Regulations that are new or have not been finalized can be found in the **Federal Register**, a document that is published daily and contains notification of government agency actions.

How do regulations ensure safe operation of hazardous waste incinerators?

EPA has developed **performance standards for the incineration of hazardous** wastes based on research on incinerator air emissions, and health and environmental risk studies. These standards have been developed under RCRA to ensure that incineration is carried out in a safe manner and poses no threat to the health of people living or working nearby or to the surrounding environment. All incinerators emit gases through a stack, or chimney, as the final step in the incineration process. These gases are composed primarily of carbon dioxide and water vapor, two harmless gases, but may contain trace quantities of pollutants, as do emissions from other fuel-burning facilities, such as power plants. The quantity of pollutants in the emissions is the major determinant of the risk of incineration. The performance standards cover emissions of **designated organic compounds, hydrogen chloride, and particulate matter.**

In addition to performance standards, owners or operators of incinerators are subject to general standards that apply to all facilities that treat, store, or dispose of hazardous waste. General standards cover such aspects of facility operations as personnel training, inspection of equipment, and contingency planning. These standards are discussed in more detail in Chapter 5.

How can EPA or the state ensure that incineration facilities will operate according to regulations?

Facilities that incinerate hazardous wastes, like other facilities that treat, store, or dispose of hazardous wastes, must apply for and receive a RCRA permit. This permit, based on a detailed analysis of the data provided by the permit applicant (either the owner or operator of the incinerator), specifies conditions for operations that ensure that the incinerator will meet all applicable RCRA standards. Permits can be issued by EPA or by states with approved RCRA programs. The procedures followed for issuing or denying a permit, including provisions for public comment and participation, are similar whether EPA or a state agency is responsible. (Chapter 3 discusses the permitting process.)

Once a permit is issued, the owner or operator of the incinerator is legally bound to operate according to the conditions specified within it. The permitting agency enforces the permit by periodically inspecting the facility to ensure that it is meeting the conditions specified in its permit. When owners or operators fail to meet the requirements of their permits, they are subject to a broad range of civil and criminal actions, including suspension or revocation of their permit, fines, or imprisonment. (A more detailed discussion of enforcement is found in Chapter 4.)

How does EPA measure incinerator performance?

To qualify for permitting, an incinerator must be able to burn wastes and cleanse combustion gases so that only very small quantities of pollutants are emitted through its stack. EPA's principal measure of incinerator performance is **destruction and removal efficiency (DRE)**. Destruction refers to the combustion of the waste, while removal refers to the cleansing of pollutants from the combustion gases before they are released from the stack. For example, a 99.99 percent DRE (commonly called "four nines DRE") means that one molecule of an organic compound is released to the air for every 10,000 molecules entering the incinerator; a DRE of 99.9999 percent ("six nines") reduces this to one molecule released out of every 1,000,000 molecules.

Do performance standards apply to all pollutants present in the original waste?

It is technically infeasible to monitor DRE results for all organic compounds contained in the waste feed. Therefore, selected hazardous compounds, called the **principal organic hazardous constituents (POHCs)**, are designated in the permit. POHCs are selected based on their high concentration in the waste feed and their difficulty to burn compared to other organic compounds in the

waste feed. If the incinerator achieves the required DRE for POHCs, then the incinerator should achieve the same or better DRE for organic compounds that are easier to incinerate.

What levels of incinerator performance do RCRA standards require?

RCRA performance standards require: (1) a minimum destruction and removal efficiency of 99.99 percent for organic compounds designated in the permit as the principal organic hazardous constituents, or POHCs; (2) a minimum destruction and removal efficiency of 99.9999 percent for **dioxins** and **dibenzofurans**; (3) removal of 99 percent of hydrogen chloride gas from the incinerator emissions, unless the quantity of hydrogen chloride emitted is less than 4 pounds per hour; and (4) a limit of 180 milligrams of particulate matter per dry standard cubic meter of gas emitted through the stack. These standards were set based on analyses of potential risks to health or the environment and the levels of performance that have been measured for properly-operated, well-designed incinerators. Although the 99.99 DRE is protective of human health and the environment, a more stringent standard of 99.9999 DRE was set for wastes containing dioxins or dibenzofurans because of EPA's and the public's concern about these particularly toxic chemicals.

Do performance standards differ for incinerators which accept PCBs?

TSCA standards are somewhat different in form from RCRA standards. For incineration of liquid PCBs, TSCA standards set a minimum "dwell" time (time in the combustion chamber), temperature, and oxygen levels. For non-liquid PCBs, the TSCA standards require 99.9999 DRE. Although the general TSCA standard for liquid PCBs should result in 99.9999 DRE, EPA requires permit applicants wishing to burn liquid PCBs to make a demonstration to prove that they will achieve 99.9999 DRE during incineration.

CHAPTER 3

PERMITS AND THE PERMITTING PROCESS

Permits are developed by determining the conditions under which a facility may operate, while meeting all applicable standards. These operating conditions are specified in the permit as the only conditions under which the facility may legally operate. The permit also specifies the maximum rate at which different types of wastes may be incinerated, maintenance and inspection procedures, training requirements, and other conditions that affect the operation of the incinerator. The permit similarly sets conditions for all other hazardous waste storage, treatment, or disposal units to be operated at the facility.

This chapter provides an overview of EPA's permitting process. The topics covered include:

- The purpose of the permit;
- How the permitting process works;
- How the public can participate in the permitting process;
- How location-related factors are considered in the permitting process; and
- Information on trial burn procedures.

PERMITS AND THE PERMITTING PROCESS

How does the permit ensure that privately owned or operated hazardous waste incinerators operate according to standards?

To ensure that the performance standards are met, the permit for an incinerator specifies operating conditions that have been proven to result or are expected to result in the incinerator meeting the performance standards. The permit may specify different operating conditions for different types of waste feeds. These operating conditions specify ranges or minimum or maximum levels for different parameters, such as temperature. The permitting agency has discretion to set operating conditions for any parameter the permitting agency considers necessary to ensure that the incinerator meets performance standards.

Can a hazardous waste incinerator operate without a permit?

Recognizing that it would take EPA and authorized states many years to process all permit applications, Congress allowed hazardous waste facilities that were under construction or in operation by November 19, 1980 to operate without a permit, providing that the facilities qualified for **interim status**. To obtain interim status, owners or operators of hazardous waste facilities were required to submit the first part, Part A, of a two-part permit application.

Part A of the permit application is a standard form, while Part B is a more extensive description of the facility, including detailed and highly technical information. It may take several years to prepare Part B of a permit application and several more for the permitting agency to complete its review and provide for opportunity for public comment. Although interim status facilities are subject to general and specific standards, these standards are less strict than those that apply to permitted facilities.

In the Hazardous and Solid Waste Amendments of 1984 (HSWA), Congress established a deadline of November 8, 1986 for submission of Part B of the permit application for interim status incinerators. Owners and operators of interim status incinerators that failed to meet this deadline will lose interim status on November 8, 1989, requiring that they close their incinerator. In HSWA, Congress also established deadlines for EPA for processing permit approvals or denials. Permit applications for incinerators received by EPA before November 8, 1984 must be approved or denied by November 8, 1989. There are currently no time limits for applications received after that date.

How are interim status incinerators permitted?

Because Congress allows interim status incinerators to operate without a permit, EPA has developed different approaches to permitting interim status and "new" incinerators (those for which construction began after November 19, 1980). Owners and operators of interim status incinerators must demonstrate that their incinerator meets all applicable performance standards by submitting **performance data** developed during actual burns. Performance data are used to determine whether the incinerator meets RCRA performance standards when burning a specific waste under a specific set of operating conditions. Many applicants develop such data for a number of different wastes and for a variety of operating conditions to support their applications. These data are developed during a **trial burn**, a test during which sufficient data are gathered to assess the incinerator's ability to meet performance standards. Although the owner or operator of an interim status incinerator does not require prior approval to conduct a trial burn, it is within the permitting agency's discretion to reject the trial burn data, if insufficient to evaluate incinerator performance. Therefore, many owners or operators of interim status incinerators seek prior approval of a trial burn plan, a detailed description of how the trial burn is to be carried out.

How are new incinerators permitted?

Anyone wishing to operate a new hazardous waste incinerator is required to obtain a RCRA permit before construction of the unit begins. The RCRA permit for a new incinerator covers four phases of operation: (1) a "shake-down" period, during which the newly-constructed incinerator is brought to the level of normal operating conditions in preparation for the trial burn; (2) the trial burn period, during which burns are conducted so that performance can be tested over a range of conditions; (3) the period following the trial burn (this period may last several months), during which time the data from the trial burn is

evaluated and the facility may operate under conditions specified by the permitting agency; and (4) the final operating period, which continues throughout the life of the permit (10 years or less).

The permitting agency specifies operating conditions for all four phases based on a technical evaluation of the incinerator design, the information contained in the permit application and trial burn plan, and results of trial burns for other incinerators. These operating conditions are set so that the incinerator theoretically will meet all performance standards at all times. Results from the trial burn are used to verify the adequacy of these conditions. If the trial burn results fail to verify that performance standards can be met under some operating conditions, the permit will be modified for the final operating phase so that the incinerator cannot operate under these conditions.

What information does the permitting agency require to determine whether an applicant should be given a permit to operate a hazardous waste incinerator?

All RCRA permit applicants must submit a complete permit application. Permit applicants for hazardous waste incinerators must also submit performance data that demonstrate the conditions under which the incinerator can meet the minimum performance standards, or, in the case of a new incinerator, a trial burn plan detailing how these data will be developed during the incinerator's trial burn.

RCRA standards specify the information that must be provided in the permit application and give the permitting agency broad authority to request any additional information it requires to identify the necessary operating conditions for the facility permit. The RCRA permit application consists of two parts, Part A and Part B. Part A provides general information including the name and location of the facility; its owner; its physical layout; and the types and quantities of wastes that will be managed at the facility. Part B, which has no standard format, contains detailed technical information on the facility's equipment, operating procedures, training and inspection programs, emergency prevention and response procedures, environmental monitoring systems, and geological and other physical characteristics. It is not unusual for a Part B application to be several volumes in length.

How is a permit application reviewed?

The process by which a permit application is reviewed may vary somewhat depending on the permitting agency. The basic process, however, consists of five steps:

(1) EPA or the authorized state reviews the application for completeness. If information is missing, the reviewer issues a **Notice of Deficiency** to request additional information from the applicant.

(2) The permitting agency evaluates the application and any other information submitted by the applicant (for example, performance data from an interim status incinerator or a trial burn plan for a new incinerator).

(3) The permitting agency prepares either a **draft permit** if it judges that the facility meets the regulatory standards, or it issues a **notice of intent to deny** the application. In either case, a notice is sent to the applicant and is published in a local newspaper. Issuance of a draft permit does not constitute final approval of the permit application. The draft permit, however, consists of all the same elements as a final permit, including technical requirements, general operating conditions, and special conditions developed specifically for the individual facility, including the duration of the permit.

(4) The permitting agency solicits and receives comments from the public during a formal **public comment period**. If requested to do so, the permitting agency will give notice of and hold a **public hearing** during the public comment period.

(5) After considering the technical merits of the comments, the permitting agency makes a final decision on the application. The permit is either issued or denied. If a permit is issued, the permit conditions are based on a careful examination of the complete **administrative record**, including all information and data submitted by the applicant and any information received from the public. The permit, as issued, may differ from the draft permit. It may correct mistakes (for example, typographical errors) or it may contain substantive changes based on technical or other pertinent information received during the public comment period. If the permitting agency intends to make substantive changes in the permit as a result of comments received during the public comment period, an additional public comment period may be held before the permit is issued.

Who decides whether or not the permit should be issued or denied?

The person with primary responsibility for evaluating the application and for writing or denying the permit is called the **permit writer**. Although he or she may be assisted by other staff in reviewing parts of the application, the permit writer will be involved in every aspect of reviewing the application, developing a proposal for responding to the application, receiving and responding to comments from the public on the proposal, and modifying the proposal, as necessary. The permit writer, by virtue of his or her technical expertise, familiarity with the facility, and involvement in every stage of the permitting process, is the key staff member responsible for determining the

operating conditions under which the facility will be able to meet applicable RCRA standards, and for making sure the permit only allows operations consistent with those conditions. The permit writer, although playing a major role in the decision process, does not make the final decision on whether to grant or deny a permit. The responsibility for that decision rests with the head of the permitting agency or with another senior agency official to whom the responsibility has been delegated.

Does EPA complete an Environmental Impact Statement before issuing a RCRA permit?

In 1979, EPA determined that preparation of an **Environmental Impact Statement (EIS)** is not required in connection with the issuance of RCRA permits. Environmental Impact Statements are required by the **National Environmental Policy Act** when actions of federal agencies may adversely affect the environment. Since the procedures for issuing RCRA permits result in a rigorous review of environmental and health considerations, the health and safety of the community and the environment can be ensured without an EIS.

What is to prevent a facility, once it has a permit, from expanding its operations?

The permit specifies limits on all aspects of operations. For example, the permit limits the maximum amount, as well as the type of wastes that can be incinerated; and specifies whether the facility can incinerate only its own wastes or can accept wastes from other generators. If the facility wishes to deviate from any conditions specified in the permit, it must apply for a permit modification. Any request to expand operations would require a major modification of the permit. For major modifications, the permitting agency must follow public notice, comment, and hearing procedures similar to those required for the original permit.

What happens if an incinerator deviates from the operating conditions specified in the permit?

During operations, the permit requires continuous monitoring of certain parameters (for example, combustion temperature) to ensure that they are within the ranges specified by the permit. If parameters deviate from these ranges, a sensor will trigger the **automatic waste feed shut-off system** which is required in all permitted incinerators. This system promptly cuts off the feeding of wastes to the incinerator. The waste feed will not resume until the required operating conditions have been restored.

How does an automatic waste feed shut-off system work?

The mechanisms that stop the waste feed differ, depending on the design of the incinerator. In one common type of system, sensors, which operate continuously, are connected to the feed valve through electrical relays. When certain operating parameters deviate from ranges set by the permit, sensors automatically trigger the closing of the feed valve. The automatic shut-off

system must be tested weekly unless the owner or operator can demonstrate that the weekly inspections unduly disrupt operations and that less frequent inspections will not affect safety. In some systems, these sensors are also connected, on separate circuits, to a back-up alarm system. Back-up alarms might consist of audio-visual displays that can alert plant operators to potential problems (if the system approaches permit or other operating limits, but is still within limits) as well as any change in parameters that would trigger the automatic shut-off system. Then, if the automatic shut-off fails, the plant operator can cut off the waste feed using manual controls.

PUBLIC INVOLVEMENT IN THE PERMITTING PROCESS

How can local residents make sure that the permitting agency considers their concerns before granting the facility a permit?

Before a permit is issued, members of the public have opportunities to express their views during the public comment period. Prior to this comment period, EPA or the state agency makes a tentative decision concerning whether to issue or deny the permit. The agency issues a **public notice** of its decision, allowing a minimum of 45 days for written comments. In the special case of permits for the incineration of wastes containing dioxins or dibenzofurans, the comment period is extended to a minimum of 60 days. Along with the public notice, the agency must prepare a **fact sheet** to inform citizens about the permitting process and the basis of the agency's tentative decision. Both the fact sheet and the draft permit are made available for public review.

Members of the public may submit written comments (including questions) to the agency during the public comment period. All comments become a part of the administrative record, which forms the basis for any subsequent action on the draft permit. Issues raised during the public comment period often cause the permitting agency to rethink certain aspects of the draft permit. The draft permit may be changed or revised because of new technical information or to address concerns about the technical operations of the facility.

Are written comments the only way citizens can participate in the permitting process?

Aside from submitting written comments, there are other means by which citizens can participate in the permitting process. EPA or the state must hold a formal public hearing on the draft permit, if someone requests one in writing during the public comment period. The hearing provides an additional opportunity for members of the public to express their views and concerns. The proceedings and any written statements received at the hearing become part of the administrative record. If a hearing is held, the public comment period is automatically extended to the close of the hearing, and may be extended beyond the close of the hearing by the hearing officer. If interest warrants, the agency may also hold informal meetings with people from within the community to hear their views and respond to questions.

After the close of the public comment period, the permitting agency carefully considers the entire administrative record for the permit application, including all written comments and any comments made during the public hearing. Comments made at informal meetings are not part of the administrative record and therefore cannot be formally considered by the permitting agency as it makes its final evaluation of the permit application. After this evaluation, the permit is written and the decision on the permit is issued, along with the **Response to Comments**, a document that summarizes and responds to all significant comments received during the comment period. This document specifies which provisions, if any, of the draft permit have been changed in the permit and the reasons for the change. Under certain circumstances, the conditions included in the permit may be appealed.

Before making any decisions, will EPA or the state consider the likely impact of the incinerator on the surrounding community?

RCRA requires that facilities operate in a manner that protects human health and the environment. To that end, federal standards for hazardous waste facilities are designed to ensure that the health of individuals in the community is protected and that the facility will not cause environmental damage. When evaluating a permit application, the permitting agency considers only those factors affecting compliance with these standards. It is not within the scope of the standards to consider the potential effects of the facility on other aspects of community life.

What if residents are opposed to the location and operation of an incinerator in their community?

During the public comment period, all members of the community are afforded an opportunity to express their concerns about the operating conditions proposed by the permitting agency in the draft permit or about any aspect of the data submitted by the permit applicant as part or in support of the application. The permitting agency will take into account any technical information relating to the ability of the incinerator to meet performance standards under the proposed permit conditions. Permitting agencies, however, do not have authority to reject permit applications on non-technical grounds. If the permit applicant demonstrates that the facility meets all RCRA standards and does not pose a threat to human health or the environment, the permitting agency must issue the applicant a permit.

Will the operation of the incinerator produce unpleasant smoke, odors, or noise that disturbs people living and working nearby?

A well-operated incinerator is smokeless and odorless. A white cloud, similar to what can be seen from a power plant, may be visible at times. These emissions are primarily water vapor. Other activities at the site, for example, storage or waste transfer, may occasionally produce odors. RCRA requires that all containers containing hazardous waste be sealed minimizing odors from wastes stored in containers. Although operation of the incinerator should not contribute to area noise levels, there may be noise from additional truck

traffic to and from the facility. EPA does not have authority under RCRA to directly regulate noise or odors from an incinerator. In some cases, local regulations may empower local authorities to address these problems.

LOCATION AND PERMITTING

Are there any prohibitions or restrictions on the location of hazardous waste incinerators?

RCRA currently includes special requirements for incinerators and other facilities located in **100-year floodplains** (areas with a 1 percent or greater chance of flooding in any given year) and bans the location of new facilities in certain areas of seismic activity. Location of hazardous waste management facilities on certain types of lands may be prohibited by the requirements of federal regulations issued under statutes other than RCRA. Lands protected by these federal statutes include archaeological and historical sites, critical habitats for endangered or threatened species, wetlands, wilderness areas, parks, wildlife refuges, coastal areas, and scenic rivers, among others. The location of an incinerator facility in such areas must be consistent with the requirements of the relevant statutes and standards or the permit application will be denied.

In addition, HSWA authorizes EPA to develop location standards for hazardous waste treatment, storage, and disposal facilities, including incinerators. EPA is currently in the process of doing so, and expects these standards to be made final in 1989.

Why is a particular location chosen for an incinerator when there may be more suitable sites?

Criteria for site selection depends on the needs the incinerator is intended to meet. Generally, a commercial waste management company is likely to consider proximity to potential customers, the cost of the land, the cost of labor, and local zoning or land use ordinances when selecting a location.

Zoning and land use are local issues. EPA develops RCRA standards so that health and the environment will be protected no matter where the incinerator is located. EPA and authorized state agencies give careful consideration to the physical suitability of the site before granting a permit. They cannot, however, deny a permit because there may be a better site elsewhere. As part of the permit application, the owner or operator must submit information on the site's location and data pertaining to its physical characteristics, including a topographical map, aspects of the site's hydrogeology, and prevailing wind patterns. The permitting agency considers this information in developing permit conditions to ensure that operations will meet all applicable RCRA standards.

TRIAL BURN PROCEDURES

What is a trial burn?

A trial burn is a test of an incinerator's ability to meet all applicable performance standards when burning a waste under a specific set of operating conditions. Before final permits for hazardous waste incinerators can be issued, owners or operators must demonstrate that their incinerator meets performance standards. Data to be used in evaluating an incinerator's performance are generally gathered by conducting a trial burn.

What happens during the trial burn?

Because data from the trial burn are the main basis for proving that the operating conditions included in the RCRA permit will result in the incinerator meeting performance standards, the trial burn is designed to provide data that demonstrates the incinerator's capabilities. Many companies hire outside contractors to conduct trial burns. During the trial burn, the owner or operator measures the waste feed rate, levels of carbon monoxide in the stack emissions, combustion temperature, combustion gas velocity, and other parameters. In order to make judgments concerning the incinerator's destruction and removal efficiency (DRE), the owner or operator must also measure the quantities of designated constituents, the principal organic hazardous constituents (POHCs), emitted from the incinerator. The permitting agency selects one or more POHCs for each waste feed tested. Emissions of particulate matter and hydrogen chloride are also measured during the trial burn, as is the efficiency of hydrogen chloride removal systems if hydrogen chloride emissions exceed 4 pounds per hour.

The waste feed burned in the trial burn may take one of three forms:

- Actual wastes or mixtures of wastes normally expected to be burned at the incinerator;
- Actual wastes with increased levels of hazardous chemicals or additional hazardous chemicals added; or
- Artificial wastes selected by the applicant that provide suitable proxies for the actual wastes.

In order to establish the most flexible permit conditions, the trial burn may involve incineration of different waste feeds using a wide range of operating conditions. This allows the development of different permit requirements for each tested waste feed, which can be advantageous if the facility anticipates that some of its wastes will be easier to burn than others. If the trial burn results demonstrate that the incinerator meets performance requirements for some waste feeds under less severe operating conditions (for example, using lower combustion temperatures), then the permit can specify more flexible operating conditions (a wider range of permissible combustion temperatures) for these waste feeds. This flexibility may help reduce operating costs of the incinerator.

What happens if the incinerator does not meet the performance standards during the trial burn?

The trial burn involves the measurement of incinerator performance under different sets of operating conditions. If the incinerator fails to meet these performance standards, the incinerator design or operation must be modified, and the trial burn must be repeated before the permitting process can proceed to the next step. Thus, in the case of an interim status incinerator, the permitting agency will not prepare a draft permit until the incinerator has been demonstrated to meet performance standards under at least one set of operating conditions.

For a new incinerator, the owner or operator will be required to apply for a permit modification before a second trial burn can be conducted. In such cases, the procedures used to evaluate the application for permit modification are very similar to procedures for the issuance of the original permit, including submission of a trial burn plan, development of a proposed modification by the permitting agency, and allowance for public participation and comment before issuance or denial of the modification. The permit will not be modified to allow an additional trial burn unless the permitting agency is satisfied that the incinerator will meet performance standards during the trial burn. Thus, the application and new trial burn plan must address in some way (either through changes in operating conditions or by modifications in equipment design) any problems identified during the initial trial burn. For example, if the incinerator failed to meet the standards for hydrogen chloride emissions, the facility operator may modify the incinerator's air pollution control equipment to improve its performance.

If the trial burn data indicate compliance with performance standards under some, but not all, tested operating conditions, the permit applicant (in the case of an interim status incinerator) or permit holder (in the case of a new incinerator) may choose not to repeat the trial burn. In the case of an interim status incinerator, the permit, if issued, will require that the incinerator operate under the conditions demonstrated during the trial burn that resulted in compliance with performance standards. For a new incinerator, the existing permit will be modified to include only the conditions demonstrated during the trial burn that resulted in compliance with performance standards. If, at any time thereafter, the permit holder wishes to expand the range of allowable operating conditions or waste feed types to allow greater flexibility, he or she must seek a permit modification.

Do all incinerators perform trial burns?

RCRA standards allow permit applicants the option of submitting performance data that can serve as a substitute for trial burn results. However, few RCRA permits have been issued to date without the performance of a trial burn. All permit applicants must demonstrate the ability of their incinerator to meet performance standards or agree to perform a trial burn, either before the permit is issued (for an interim status incinerator) or after (for a new incinerator). If an applicant chooses to submit data in lieu of a trial burn, these data must demonstrate the conditions under which the incinerator will achieve the minimum

performance standards for specific wastes covered by the application. If the data are not considered adequate, the permit writer requests the applicant to submit other data or agree to perform a trial burn. Acceptable data are therefore limited to performance data from similar or identical incinerators that were burning similar or identical wastes to those covered in the application. Applicants operating an interim status incinerator could develop these data during normal operations. Applicants for a new incinerator might submit trial burn data from an incinerator with identical design to the one covered by the application.

Given that new incinerators are untested, could the conduct of the trial burn pose a serious risk to human health and the environment?

A trial burn is conducted to show that the incinerator can operate in a manner that protects nearby residents and the surrounding environment. Therefore, during the trial burn, the incinerator will be operating only under conditions that the permitting agency judges will result in the incinerator meeting the performance standards. Occasionally, an incinerator may fail to meet the performance standards during a trial burn. The risk to the environment and the public in such cases is minimal due to the short duration of these tests.

To ensure that trial burns will be properly planned and executed, RCRA standards require that the owner or operator of a new incinerator develop a detailed trial burn plan. The plan proposes operating conditions for the trial burn, provides a description of all emission control equipment to be used, and explains the procedures for stopping the waste feed, shutting down the incinerator, and controlling emissions in the event of any problems. The trial burn plan is submitted with the permit application, reviewed by the permitting agency, and is not approved unless the permitting agency judges that the incinerator will meet all standards throughout the trial burn, and that any departure from this expected level of performance will not pose an imminent hazard to health or the environment.

How are the results of the trial burn evaluated?

Within 90 days following the trial burn, the applicant must provide data from the trial burn and analysis of these data for each waste feed incinerated during the trial burn. All data collected by the applicant must be submitted to the permitting agency for evaluation. The 90-day period following the trial burn allows time for analyzing both the samples collected and other pertinent data.

After the data have been submitted, the permit writer reviews the data to determine whether the performance standards were met and under what range of operating conditions. For each set of operating conditions used during the trial burn, the permit writer either calculates or reviews the applicant's calculations for destruction and removal efficiency for each POHC, the efficiency of the hydrogen chloride removal system if hydrogen chloride emissions exceeded 4 pounds per hour, and the concentration of particulate matter in stack emissions.

How are the results of the trial burn reflected in the permit?

For each type of waste feed to be burned by the incinerator, the permit specifies a set of operating conditions consistent with those conditions demonstrated during the trial burn to result in compliance with the performance standards. At a minimum, the permit specifies operating conditions for combustion gas carbon monoxide levels, waste feed rate, combustion temperature, combustion gas flow rate, and acceptable variations in the waste feed composition. The operating conditions may allow for normal fluctuations in these parameters that do not affect performance, as demonstrated during the trial burn. For example, the combustion temperature specified in the permit can be expressed as a range of values over which compliance with the performance standards has been demonstrated. In addition, the permit writer may specify other operating conditions deemed necessary to ensure compliance with the performance standards.

After review of trial burn data from an interim status facility, the permitting agency prepares a draft permit based on the trial burn results. For a new facility, if the data from the trial burn show that the operating conditions included in the permit for the final operating period are sufficient, the facility may enter into this phase of operations. Otherwise, the permit will require modification before this phase of operations may begin.

CHAPTER 4

ENFORCEMENT OF PERMIT OPERATING CONDITIONS

After a permit is granted, the permitting agency must make sure that the facility complies with all permit conditions. Facility inspections are the main tool by which federal or state officials monitor for compliance. An inspection is a formal visit to a facility to review records, take samples, and observe facility operations. EPA conducts inspections in all states, including those states with their own RCRA programs. Authorized states will also have their own inspection programs. Local authorities and local residents can also play a role in making sure that facilities comply with RCRA regulations.

How will EPA or the state ensure that incinerator operations meet the requirements of the permit?

The principal goal of the RCRA compliance monitoring and enforcement program is to ensure that the regulatory and statutory provisions of RCRA are met. If a facility fails to comply with all provisions of its permit, the permitting agency has at its disposal various **enforcement** measures, including administrative actions, civil actions, and criminal actions.

Administrative actions provide enforcement outside of the court system. These actions may be informal, such as a phone call or letter notifying the facility of a problem. Continued violation may necessitate a warning letter that specifies the action required and that describes enforcement measures that will be taken if the action is not taken by a specific date.

Besides these informal actions, the permitting agency can issue **administrative orders**. These orders are legal documents that compel the permit holder to take action in accordance with the terms of the permit, as indicated in the administrative order. Administrative orders can assess penalties for non-compliance and can suspend or revoke the permit (or interim status, if applicable).

Civil actions are law suits that are either settled by negotiation or tried in court. The permitting agency may pursue a civil suit when administrative orders are ignored or where dangers to human health and the environment are significant (for example, if non-compliance results in a release of hazardous waste). Civil suits can seek penalties and suspension or revocation of the permit or interim status. Criminal actions are pursued for the most serious violations. Section 3008 of RCRA identifies seven violations that carry criminal penalties. Penalties for six of the seven violations can include a fine of up to $50,000 per day or a prison sentence of up to 5 years. The seventh and most serious offense could include a penalty of up to $250,000 or 15 years imprisonment. An example of a criminal violation is knowingly transporting waste to a facility not covered by a permit or by interim status.

What occurs during an inspection?

The main purpose of any inspection is to determine whether the facility is operating in accordance with the terms of its permit. An inspection typically consists of the following steps:

- Before visiting the facility, the inspector reviews the facility's permit and other agency records on the facility to identify any problems that may be encountered.

- The inspector enters the facility, identifies himself or herself, and describes the nature of the inspection. An opening conference is held with the owner or operator to describe the information and samples to be gathered.

- The facility is inspected. The inspection includes examination of facility records, possible collection of samples, and observation of the facility including the incinerator and any other hazardous waste management operations. The inspector will also observe all associated activities, such as unloading of wastes, lab work, and safety procedures. The inspector may use field notebooks, checklists, and photographs to document the visit.

- The inspector holds a closing conference with the owner or operator to respond to questions about the inspection and provide additional information.

- The inspector prepares a report summarizing the results of the inspection, including the results of sampling. Violations of the permit are documented in the report. Inspections usually last between one day and a week.

If the facility is in violation of the permit, enforcement actions may be taken. Enforcement actions can range from informal actions to criminal judicial cases, depending on the severity of the violation. The severity is determined by the likelihood that the violation will pose a threat to human health or the environment. For example, some recordkeeping violations would be judged less severe than operating violations that affect incinerator performance. The EPA regional offices have broad discretion in these matters.

Why aren't there government inspectors at the facility at all times, or at least whenever the incinerator is operating?

To date, EPA has not exercised its authority under RCRA to require that facilities accept a full-time inspector, or to require a facility to pay expenses related to full-time inspectors. Other methods are used to ensure a satisfactory inspection program. First, EPA's current inspection program uses a variety of techniques to provide adequate monitoring of facility activities without maintaining a full-time inspector at each facility. These techniques

include periodic inspections (both announced and unannounced), interviews with facility personnel, and frequent contacts and cooperation with state inspectors. Second, the regulatory requirement that operating parameters be linked to automatic waste feed shut-off is meant to ensure that the operating conditions in the permit are maintained at all times. (See page 20 for an explanation of automatic waste feed shut-off.) The incinerator control system must be designed so that if operating conditions vary from the allowable ranges, all waste feed to the unit is immediately cut off and the incinerator shuts down its destruction activities. Third, in authorized states, incinerators are subject to state enforcement authority and inspections. Some states, as part of their enforcement program, require that inspectors be present at hazardous waste management facilities at all times. The use of full-time inspectors is a matter of state law in authorized states, and is not part of the RCRA federal program.

How often will the facility be inspected by the permitting agency?

RCRA requires that all federal- or state-operated facilities be inspected at least annually and that all other hazardous waste generators and management facilities be inspected at least once every 2 years. EPA has successfully encouraged more frequent inspections. Inspections are scheduled by states and EPA regional offices according to criteria that ensure greater attention to facilities of greater concern. Inspections may also be conducted at any time based on suspicion that a violation is occurring. Finally, facilities may be chosen for an inspection when specific information is needed to support the development of additional RCRA standards.

Is the facility given notice before an inspection is made?

Normally, facilities are given notice of an upcoming inspection. Advanced warning does not diminish the effectiveness of the inspection because the primary purpose of a routine inspection is to examine ongoing facility records. These records are generally more revealing of ongoing practices than observations of facility operations on a single day. In cases where a facility has or is believed to be violating the requirements of its permit, unannounced and more frequent inspections are more common. The decision concerning notice of an inspection is generally left to the discretion of the inspecting agency.

In terms of enforcement, will local authorities have any responsibility for ensuring that the facility operates safely and in accordance with regulations?

The permitting agency cannot delegate its enforcement responsibilities to local authorities. Agencies at the local level, however, can play a significant role in monitoring facilities within their jurisdiction. To the extent that local agencies actively enforce local regulations (for example, fire and safety rules), are knowledgeable about RCRA requirements and about the activities being carried out at the facility, these agencies can help ensure that an individual facility operates safely and consistently within the conditions of its permit. By sharing information with EPA or the appropriate state agency concerning possible violations of requirements or possible hazards, local authorities and citizens help in the enforcement effort.

What should local residents do if they have complaints about a facility or wish to inform someone of something they have observed?

Citizens should contact the regional EPA office or the state environmental agency to describe any problems they perceive (see page 44). EPA's or the state's response to the complaint will depend on the potential severity of the incident or condition involved. This response could range from an on-site investigation of the problem to a telephone inquiry to the facility. EPA welcomes the active participation of citizens on issues involving hazardous waste, including formal and informal involvement in all aspects of permitting and the enforcement of permits. The public is entitled to review reports, data, and records maintained by EPA concerning a specific facility including, for example, inspection reports. Some limited types of information received from some facilities may be designated "Confidential Business Information" and will not be available for review in order to protect trade secrets.

CHAPTER 5

GENERAL STANDARDS FOR FACILITIES OPERATING HAZARDOUS WASTE INCINERATORS

This section discusses the general standards that apply to all facilities that treat, store, and dispose of hazardous wastes, including facilities operating hazardous waste incinerators. The standards appear in Volume 40 Part 264 of the Code of Federal Regulations and were developed to ensure that these facilities are properly designed, operated, and maintained. They include provisions covering accident prevention, planning and equipment for emergencies, waste transportation, waste testing and storage, recordkeeping, personnel training, and insurance and closure requirements, among other topics.

This chapter also describes specific standards for tanks and containers. Tank and container standards are included because these types of units are more commonly used in association with incinerators than other types (for example, surface impoundments and waste piles). Facilities operating other types of hazardous waste management units are subject to specific standards for these units. For information on these standards, contact the EPA regional office for your area (see page 44).

The chapter provides information on the following topics:

- The safe transportation of hazardous waste to the facility;
- Prevention of spills and leaks during storage;
- Requirements for handling incompatible, reactive, and ignitable wastes;
- Management of treatment residues;
- Routine inspections of the facility and training of employees;
- Procedures and requirements that protect the public and facility personnel in the event of a spill or an emergency at the facility;
- Liability insurance;
- Protection from floods;
- Measures required for the maintenance of security; and
- Procedures required when the facility ceases operations.

TRANSPORTATION AND STORAGE OF WASTES

What regulations ensure that hazardous wastes will be transported safely to the incinerator facility?

Transporters of hazardous waste are regulated jointly by EPA under RCRA and by the Department of Transportation (DOT) under the Hazardous Materials Transportation Act (HMTA). Under HMTA, DOT ha set standards for the transportation and labeling of shipments of ha: rdous materials, including hazardous waste. These standards cover shippin containers and labeling; placarding of vehicles; design, construction, and maintenance of containers (for example, tanks); and the use of shipping papers. Under the Motor Carrier Act, DOT has developed additional standards for driver qualifications and training as well as the design, construction, and maintenance of vehicles.

RCRA standards require that each hazardous waste transporter obtain an identification number before it can legally accept wastes for shipment (except in certain emergency situations). Transporters are required to take immediate action to notify the proper authorities if an accident causing a release of hazardous waste occurs, and are liable for the cost of cleaning up any spills that may occur. RCRA standards also require use of a special manifest form (acceptable under HMTA standards for shipping papers).

The RCRA manifest system allows tracking of individual waste shipments. The generator fills out a manifest form that designates a final destination point for the waste (for example, a specific incinerator facility). Each time the shipment changes custody (generator to transporter, transporter to incinerator facility), the manifest is signed to acknowledge the transfer of custody and a copy is retained by each party. When the shipment reaches the designated facility, the owner or operator of the facility must send a copy of the completed manifest to the generator. If the generator does not receive a copy of the manifest, the generator must contact the transporter and the designated facility. If, after 45 days, the generator still does not receive the completed manifest, the generator must contact EPA. The manifest system allows EPA to keep track of wastes that are accidentally spilled and helps to prevent illegal disposal practices, such as "midnight-dumping."

Will problems occur because of the storage of wastes before incineration?

At any facility where hazardous waste is stored, there is a possibility of leaks and spills. When wastes are stored or transferred from one storage vessel to another, for example, small amounts of vaporized pollutants may be released. These releases are referred to as **fugitive emissions**. These emissions will occur at all sites at which hazardous wastes are managed, including incinerator sites. To ensure that problems do not occur during storage of wastes, RCRA regulations require that the facility be designed, constructed, operated, and maintained to minimize the possibility of releases and to prevent accidental releases from causing adverse health or environmental effects. Hazardous wastes destined for incineration are typically stored in containers or tanks. Containers are generally portable and can be sealed to prevent the release of vapors, dusts, or liquids. Common containers for storing hazardous waste

include hoppers and metal drums. Standards for hazardous waste containers require that containers be inspected weekly and that the contents be transferred from any container found in poor condition. Containers must be closed during storage and can only be opened when wastes are being sampled or transferred to or from the containers. Containers must be stored in areas with "secondary containment" (that is, areas in which any leaks or spills will be safely held until they can be cleaned up).

Tanks are stationary structures that are designed, constructed, and maintained as part of the facility. They may be installed above or below ground. For each tank, the facility must obtain certification from a registered professional engineer that the tank will withstand expected physical and chemical stresses. A corrosion expert must also certify that tanks with external portions in contact with soil or water will withstand this contact throughout the period during which the tanks will be used. All tanks must be equipped with a secondary containment system (a structure that holds potential leaks or spills until they can be cleaned up). These systems must be designed so that leaks or failure of the tank or the secondary containment system itself are detected within 24 hours. RCRA standards require daily inspections of tanks.

HANDLING OF WASTES AT THE FACILITY

What happens to a shipment of waste from the time it arrives at the facility until the time it is incinerated?

Before a facility may treat or accept a waste for management, it must perform a detailed chemical and physical analysis to ensure that the waste may be managed under the conditions of its permit and to determine the proper method of managing the waste. These procedures are fully described in the facility's Waste Analysis Plan, which is a part of its permit application and which is incorporated by reference in the facility permit. Subsequent shipments of the same waste must be sampled and examined, and detailed analyses performed if there is any reason to believe that the waste's characteristics have changed. In any case, the facility can accept wastes only if the wastes are allowed under its permit conditions. Otherwise, it must refuse to accept the waste and the shipment must be returned to the generator. In the event that a waste shipment deviates either from the specifications of the accompanying manifest or from characteristics expected from earlier analyses, the facility must follow procedures specified in the Waste Analysis Plan for resolving the discrepancy.

Once a shipment of waste has been accepted, it may be stored at the facility before being incinerated. The period of time a waste is stored before incineration varies. Facilities handling various waste types which must be incinerated separately may store a particular waste until enough has accumulated to justify a continuous burn. In some cases, wastes may be blended together or treated (for example, metals removed) prior to incineration. Any storage, treatment, or blending of wastes will be fully addressed in the facility's permit.

How does a facility keep track of all the different types of wastes it receives so that incompatible, reactive, or ignitable wastes are handled properly?

The facility's Waste Analysis Plan must ensure that the facility will perform any necessary analyses to determine which wastes are incompatible, reactive, or ignitable. The plan also specifies the measures to be taken if such wastes are identified. Mixing or other contact between incompatible wastes may produce heat or pressure; fire or explosion; violent reaction; toxic dusts, mists, fumes, or gases; or flammable fumes or gases. RCRA standards prohibit storage or treatment of incompatible wastes in the same container or tank unless the wastes are mixed according to a proven, safe procedure. If a waste is to be placed into an empty tank which previously held an incompatible waste, the tank must first be cleaned. Incompatible wastes stored or treated near each other must be placed in container areas or tanks having separate secondary containment systems.

RCRA standards include explicit criteria for identifying ignitable and reactive wastes. Ignitable wastes include liquid wastes with **flash points** less than 140°F; non-liquid wastes that under standard pressure and temperature could cause fires through friction, absorption of moisture, or spontaneous chemical changes; certain compressed gases; and oxidizers. Reactive wastes generally are those that react violently; form potentially explosive mixtures; produce toxic vapors, gases, or fumes in the presence of water; or undergo detonation or explosive reaction when exposed to a strong initiating source.

Ignitable and reactive wastes must be separated and kept away from sources of ignition or reaction during storage. Wastes that are unstable at normal temperatures may be cooled during storage. Tanks and auxiliary piping systems for the storage of water-reactive wastes are designed to eliminate the possibility of water being introduced accidentally to the tanks. Ignitable and reactive wastes may be handled only in areas where smoking and open flames are prohibited. Containers with ignitable or reactive waste must be located a minimum of 50 feet inside the facility's property line. For tanks storing these wastes, the facility must follow the National Fire Protection Agency's "Flammable and Combustible Liquids Code" to determine the minimum safe distance from public ways, streets, alleys, or adjoining property.

How are treatment residues, such as ash from the incinerator, managed?

All residues from hazardous waste treatment are considered, by regulation, to be hazardous. Incineration byproducts, including ash and any wastewaters from cooling or air pollution control devices, are therefore subject to the requirements governing transportation, treatment, storage, and disposal of hazardous wastes. Incinerator ash is generally disposed in a hazardous waste landfill. Wastewaters are often disposed through the sewer system or discharged to a river or stream. In these cases, the wastewaters must be managed according to Clean Water Act standards, as well as RCRA standards, before discharge. Disposing of wastewaters in streams and rivers requires a National Pollution Discharge Elimination System (NPDES) permit. These permits place restrictions on the quantity of wastewaters released, the level of pollutants in the water,

and other characteristics (such as temperature) To meet these requirements, the facility may treat its wastewaters before disposal. Disposal through the sewer system may also require that the wastewaters be treated to meet Clean Water Act standards.

RCRA standards allow for exemptions to the requirements that treatment residues be managed as hazardous wastes. If the owner or operator of the facility can prove to EPA that the byproducts are not hazardous, the owner or operator can obtain an exemption from these requirements. This exemption, called a delisting, is issued by EPA on a case-by-case basis. Regardless of whether the wastewaters are considered hazardous or not, if they are to be disposed by release to a stream or river or through the sewer, the owner or operator must comply with the Clean Water Act.

INSPECTIONS AND TRAINING

How will equipment malfunctions or other problems be detected?

RCRA standards require that all monitoring equipment, safety and emergency equipment, and operating and structural equipment which prevents, detects, or responds to spills or releases be inspected by the owner or operator according to a written schedule. The inspection frequency for each item depends upon its expected rate of deterioration and the probability of adverse effects to nearby residents or the environment should the item fail. The inspection schedule is submitted with Part B of the permit application and is incorporated by reference into the permit.

Loading and unloading areas, and other areas where spills may occur, must be inspected daily when in use. Tank systems must be inspected daily, while container storage areas must be inspected at least weekly for leaking containers and deterioration of containers and containment systems. The data from monitoring and leak detection equipment must be reviewed on a daily basis. Deterioration or malfunctions must be remedied immediately if a hazard is imminent or already exists. If there is no imminent hazard, the situation must be remedied on a schedule that ensures that there is no harm to nearby residents or to the environment.

Will employees be able to recognize and respond quickly to problems?

RCRA standards require that facility personnel be trained to perform their jobs safely and to respond properly to both emergencies and more routine problems. Employees must know the procedures for emergency shutdown of operations and understand the operation of the incinerator's automatic waste feed shut-off system. They must be trained in the use of alarm and communications systems and trained to respond to fires, explosions, spills, and leaks. Personnel must also be trained to inspect, repair, and replace emergency and monitoring equipment.

Employees must complete their training within six months of employment at the facility or assignment to a new position. Employees may not work unsupervised until training is complete. All personnel must take annual review courses. An outline of the training program and a description of how the program will correspond to actual job tasks must be included with Part B of the permit application and is included as a part of the facility permit.

SPILLS AND EMERGENCIES

What if leaks or spills occur that nobody notices?

Areas where spills or leaks are likely to occur are frequently inspected according to a set schedule. Thus, a spill, if undetected at the time it occurs, will be detected soon after. Areas where wastes are transferred or stored must have spill containment systems. These systems facilitate clean up and help prevent adverse consequences from spills. Detection of leaks can be aided by automatic leak detection systems, and backed up by manual inspections. Automatic leak detection equipment and spill containment systems are frequently inspected to ensure their integrity.

What if spills occur during the transfer of wastes from truck to tanks or other storage containers?

If spills occur, they must be cleaned up as soon as possible. To contain any spills that occur, loading and unloading areas must be designed to collect liquids and must have a base impervious to liquids. Large spills collect in a slump and may be cleaned up by pumping the waste into containers. Small spills can be picked up with an absorbent material designed specifically for use with hazardous waste. The chances of a spill are probably greatest when wastes are transferred from one container to another. Spills can be prevented, however, with a combination of strict procedures, training of personnel, and good process design, all of which are covered in the permit. Spill prevention procedures include draining liquids and bleeding pressure from connection lines before wastes are transferred.

How do facilities plan ahead in case of an emergency, such as a fire or explosion?

Every hazardous waste incineration facility must regularly inspect and maintain emergency equipment, such as fire extinguishers and sprinklers, and have adequate alarm systems for notifying facility personnel of emergency situations. All facilities are required to have an evacuation plan. This plan is part of the facility's Contingency Plan for responding to emergency situations. The Contingency Plan is a required part of Part B of the permit application and is incorporated by reference into the permit.

A copy of the Contingency Plan must be maintained at the facility and copies must be distributed to all local officials who may be involved in emergency response. The plan must inform police, fire departments, and emergency response teams of the facility layout; identify the characteristics of the hazardous

astes present; describe the hazards associated with the wastes and the rocesses in use; indicate the probable location of employees during normal perations; and designate personnel evacuation routes from the facility. The lan must designate one fire department as the primary authority in an emergency or which such assistance is required. The plan also describes the actions acility personnel will take in the event of an emergency.

The plan must contain the names, addresses, and phone numbers of facility ersonnel qualified to act as "emergency coordinators." The emergency oordinator has the authority to take any action necessary to carry out the ontingency Plan and must be knowledgeable of the plan, all operations and ctivities at the facility, the location and characteristics of all wastes, and he location of all records within the facility. A designated emergency oordinator must be at the facility or on call at all times.

What will happen if an emergency occurs?

If a release, fire, or explosion occurs, the emergency coordinator must:

- Alert facility personnel;
- Notify local agencies if their help is needed;
- Identify the character, amount, source, and extent of any releases; and
- Assess possible hazards to human health and the environment.

f the coordinator determines that a threat exists, the appropriate officials ust be advised on whether surrounding areas should be evacuated. Measures must e taken to ensure that fire or explosion does not recur, or spread to other astes. After the emergency, released wastes and materials contaminated with eleased wastes must be recovered and stored for proper treatment or disposal.

How will individuals or the community be compensated for any negative effects of accidents at the facility?

RCRA regulations require that owners or operators be financially responsible or both sudden and non-sudden accidental occurrences due to operations at a acility. All owners or operators must carry liability coverage to compensate ndividuals for bodily injury or property damage caused by sudden accidental ccurrences. Owners or operators of facilities with one or more landfills, urface impoundments, or land treatment units must also have liability coverage or non-sudden accidental occurrences.

How will the facility be secured from vandals or unauthorized visitors?

The active areas of the facility must be completely enclosed by a fence or ome combination of artificial and natural barriers that restricts entry. ntrance to the active, enclosed areas must be controlled and monitored at all imes.

CLOSING THE FACILITY

What will happen to the site when the facility ceases operations?

When the facility or any single waste management unit at the facility ceases operations, the facility or unit will be "closed" in accordance with a plan that has been approved by EPA. For a permitted facility, the closure plan is submitted with Part B of the permit application and becomes a part of the permit. For an interim status facility, the owner or operator submits a plan to EPA before closure begins. EPA makes this plan available to the public for comment. Following the comment period, EPA may decide to approve, modify, or disapprove the plan. For both interim status and permitted facilities, the plan details a set of actions and sets a timetable for closure. Following the completion of all plan activities, the owner or operator and an independent, registered professional engineer must certify that the facility has been properly closed.

Closure involves all aspects of the facility's waste management operations. For a facility operating only storage and incineration services, closure would involve the removal and proper disposal elsewhere of any wastes or waste residues. It also would require decontamination or proper disposal elsewhere of all structures in which wastes were handled and any equipment that came into contact with wastes, such as blending and storage tanks and the incinerator itself. Because incineration is a treatment rather than a disposal process, closure of an incinerator would result in the removal of all hazardous wastes from the site, and continued care measures would not be required. If there were spills or other types of contamination at the incinerator site that could not be adequately removed at the time of release, long term clean up measures (corrective action) would be required.

How does RCRA ensure that the owner/operator has funds available for closure?

RCRA regulations establish financial requirements to ensure that funds are available to pay for closing a facility. For closure, owners or operators must prepare a written cost estimate for closing the facility. These estimates must reflect the actual cost of conducting all the activities outlined in the facility's closure plan, and are adjusted annually for inflation. The cost estimate for closure is based on the point in the facility's operating life when closure would be the most expensive. Following preparation of the closure cost estimate, the owner or operator must demonstrate to EPA the ability to pay the estimated amounts. This is called **financial assurance for closure**. RCRA regulations describes several mechanisms for guaranteeing financial assurance for closure activities, including use of a trust fund, or a letter of credit, among others. All mechanisms require annual adjustments for inflation or changes in cost estimates. If, for any reason, the owner/operator should declare bankruptcy and does not provide funds for closure, EPA would become one of the facility's creditors to obtain these funds.

CHAPTER 6

POTENTIAL RISKS OF HAZARDOUS WASTE INCINERATION

Hazardous waste incineration, like other industrial operations, is not without risk. Some risks are associated with incineration itself; others are associated with related operations, such as the transportation and storage of the hazardous waste. RCRA requires EPA to examine risks that could be associated with activities involving hazardous wastes and to develop standards that protect human health and the environment. This chapter outlines the risks associated with hazardous waste incineration and briefly describes the standards developed by EPA and other agencies. Chapters 2 through 5 provide more detailed information on the specific requirements of RCRA standards.

Do emissions from hazardous waste incinerators cause health and environmental problems?

EPA believes that a well-designed and properly-operated incinerator will not cause health or environmental problems. Based on the best available information concerning the risks of incineration, EPA has developed standards that place strict limits on the quantities of pollutants in emissions from hazardous waste incinerators.

Hazardous waste incinerator emissions contain small quantities of metals and uncombusted organic compounds. The organic compounds consist of trace levels of the organic compounds in the hazardous waste feed as well as products of incomplete combustion (PICs), formed during the combustion process. EPA standards limit emissions of designated organic compounds in the waste (called principle organic hazardous constituents, or POHCs) and particulate matter. To ensure that emissions of total residual organic compounds and metals are minimized to acceptable levels, EPA is developing regulations that would strengthen the existing controls to directly regulate these emissions. In the interim until those regulations are promulgated, permit writers can implement the controls on a case-by-case basis as necessary to protect human health and the environment.

How are risks from hazardous waste incineration estimated?

Potential human health risks can be measured using **risk assessment** techniques. Risk assessment uses established methods to evaluate the relationship between exposure to toxic substances and the subsequent occurrence of disease. A thorough risk assessment considers not only possible risks from day-to-day operation, but also risks caused by abnormal operation ("upset" conditions), and accidents. Some risk assessments involve fairly simple calculations using conservative screening values to determine worst-case risks, while others involve complex computer models. EPA has developed air dispersion models and health effects data for use in risk assessment. EPA is continuing to update this information and to develop further guidance in the area of risk assessment.

Risk assessment of hazardous waste incineration examines two factors--the

toxicity of the pollutants emitted from the incinerator, and the magnitude of exposure of humans to these pollutants. Toxicity is a measure of the type of adverse effects a pollutant may cause in humans or other species. Exposure is the estimated amount of human contact with the pollutant that occurs. A risk assessment estimates the probability of adverse health effects occurring as a result of human exposure to a pollutant with a specified toxicity.

To measure the health risk from hazardous waste incinerator emissions, several steps must be taken. The first step is to measure emissions or to estimate them based on the incinerator's technical specifications (destruction and removal efficiency or DRE) and the types and quantities of waste to be burned in the incinerator. To predict the concentration of pollutants in the air, models can be used that account for dilution and dispersion of the pollutants as they move away from the incinerator. Based on estimates of pollutant concentrations at various locations, it is possible to determine the maximum pollutant concentration. Using conservative assumptions (for example, lifetime exposure to the maximum pollutant concentration) and toxicological data, health risks can then be identified and quantified.

Do risk assessments ever underestimate or overestimate risks?

Risk assessments always involve assumptions and thus include some degree of uncertainty. These assumptions influence the outcome of the risk assessment; if the assumptions are conservative, the risk assessment will tend to overestimate risks. Both conservative and nonconservative assumptions are commonly used. An example of a nonconservative assumption is that synergism between compounds does not occur (that is, compounds do not interact to cause risks greater than the sum of the risks from exposure to each individual compound). Conservative approaches often used in risk assessment include basing risk estimates on lifetime exposures at the point of maximum ground level concentrations of pollutants (essentially assuming that individuals are exposed to the maximum concentrations for 70 years) and using safety factors so that risk estimates reflect risks to the most sensitive people (that is, the people most likely to experience effects from exposure). On balance, EPA risk assessments are conservative by design, and will tend to overestimate risks.

What are the risks from hazardous waste incineration?

Reasonable, worst-case estimates of health risks posed by metals and organic compounds in emissions for a permitted hazardous waste incinerator range from one chance in 100,000 to one chance in 100,000,000 of contracting cancer over a lifetime. These conservative estimates assume 70 years of continuous exposure at the point where pollutant concentrations would be the highest.

To put the above figures into context, the death rate from motor vehicle accidents in 1986 was 19.6 per 100,000 population, or approximately one chance in 100 lifetime risk.[1] For various regulatory purposes, EPA has considered acceptable risk levels for hazardous waste regulatory programs to range from a lifetime risk of one chance in 10,000 to one chance in 10,000,000. Levels of

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[1] The World Almanac and Book of Facts, 1988; Editor, Mark S. Hoffman.

acceptability vary depending on the nature of the risks involved and the types of activities associated with the risk.

How do EPA performance standards protect human health?

EPA sets performance standards to control the amount of pollutants which are emitted from hazardous waste incinerators. EPA's principal measure of performance is destruction and removal efficiency (see chapter 2 for a more detailed discussion). A 99.99 percent DRE means that one molecule of a chemical is released to the air for every 10,000 molecules entering the incinerator. These performance standards set limits on the amount of pollutants allowed in emissions, given the amount of waste which is burned. Only a very small percentage of toxic substances originally contained in the waste can be released into the air. EPA has done numerous studies which indicate that incinerators meeting EPA's performance standards pose no significant health hazards.

EPA's current incinerator regulations also include performance standards limiting the amount of particulate matter and hydrogen chloride emitted. As discussed above, EPA is in the process of strengthening the current standards to directly control emissions of total residual organic compounds and toxic metals

Although EPA regulations do not require owners or operators to perform risk assessments, many companies develop risk assessments in support of their permit applications. Permit writers have the authority to require more stringent risk-based operating conditions in the permit when necessary to provide adequate protection of human health and the environment, in addition to operating conditions required to meet regulatory performance standards. Although EPA believes that hazardous waste incinerators meeting performance standards will not cause health or environmental problems, a permit writer may occasionally require additional safeguards to provide extra assurance that problems will not occur.

What are the risks involved during the transportation of hazardous waste to the site?

Activities involving the handling of hazardous wastes always involve some risk that wastes will be released to the environment. These are the same types of risks that are involved in the transportation of chemicals to industrial plants. Hazards can be reduced through proper planning, use, and maintenance of equipment, and development of safety-oriented procedures. Among the potential hazards are releases caused by accidents while transporting the hazardous waste to and within the facility, and leaks and spills during the transfer of wastes to and from the vehicle.

EPA requirements for transporters cover emergency procedures and the use of a special form, called a manifest, that allows the tracking of individual waste shipments. RCRA standards require transporters to take immediate action to notify the proper authorities if an accident causing a release of hazardous waste occurs. Transporters are liable for the cost of cleaning up any spills that may occur. Transporters that fail to handle waste properly are subject to financial penalties. In addition, RCRA standards require procedures that minimize the chance of leaks or spills occuring during transfer of wastes, and

which ensure that leaks and spills that do occur are quickly and safely cleaned up. Transporters of hazardous waste are also required to follow Department of Transportation (DOT) standards. (For more information on DOT standards see Chapter 5.)

What are the chances of a fire or explosion occurring?

Fires and explosions are always possible at any industrial facility, such as a petroleum refinery, where ignitable, pressurized, or reactive substances are present. All incinerators require the use of fuel; in addition, some of the wastes being treated may be ignitable or reactive. RCRA standards ensure proper handling, storage, and incineration of such wastes so that there is very little chance of fire or explosion. For example, standards require isolating ignition sources from ignitable hazardous waste during storage and prohibit mixing incompatible substances. Incompatible wastes must be stored and treated separately so that there is no possibility of accidental mixing.

Department of Transportation regulations outline procedures for safe packaging, handling, and storage of ignitable and reactive wastes that are transported. Applicants for a RCRA permit are also required to provide a complete chemical analysis of wastes they propose to incinerate, to use engineering controls to monitor operation, and to develop contingency plans and institute emergency response procedures that ensure quick and appropriate measures in response to incidents at the facility. Facilities must provide the local police and fire departments with information on the types of waste that are handled. RCRA contingency planning and emergency response procedures are discussed in greater detail in Chapter 5.

Title III of the Superfund Amendments and Reauthorization Act (SARA) of 1986 established a regulatory program entitled the "Emergency Planning and Community Right-to-Know Act." The Act requires facilities to disclose information about hazardous chemicals handled at the facility. This law also mandates the formation of State Emergency Response Commissions and Local Emergency Planning Committees. These groups are responsible for formulating emergency response plans for chemical mishaps.

What if there is a bad storm or flood at the facility?

Storms, floods, or other natural disasters have the potential to damage any structure or facility. In the case of hazardous waste incinerator facilities, RCRA regulations define standards ensuring containment of hazardous wastes in the event of certain natural disasters. A facility located in a 100-year floodplain (an area that has a 1 percent or greater chance of being flooded in any given year) is required to be designed, constructed, operated, and maintained to prevent release of hazardous wastes should a flood occur. In addition, the facility permit will require stormwater management techniques to ensure that any stormwater that enters areas where wastes are handled is collected, tested, and treated as necessary before being disposed.

CONTACTS FOR FURTHER INFORMATION

RCRA/Superfund Hotline

Toll Free: (800) 424-9346
In the Washington D.C. area: 382-3000

EPA Regional Offices

Region I	Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont	EPA John F. Kennedy Federal Bldg. Boston, MA 02203 (617) 573-9644
Region II	New Jersey, New York, Puerto Rico, Virgin Islands	EPA 26 Federal Plaza New York, NY 10278 (212) 264-8682
Region III	Delaware, D.C., Maryland, Pennsylvania, Virginia, West Virginia	EPA 841 Chestnut Street Philadelphia, PA 19107 (215) 597-7940
Region IV	Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee	EPA 345 Courtland Street, NE Atlanta, GA 30365 (404) 347-3433
Region V	Illinois, Indiana, Michigan, Minnesota, Ohio, Wisconsin	EPA 230 South Dearborn St. 13th Floor - (HR-11) Chicago, IL 60604 (312) 353-0398
Region VI	Arkansas, Louisiana, New Mexico, Oklahoma, Texas	EPA First International Building 1201 Elm St. Dallas, TX 75270 (214) 655-6785
Region VII	Iowa, Kansas, Nebraska, Missouri	EPA 726 Minnesota Ave. Kansas City, KS 66101 (913) 236-2888
Region VIII	Colorado, Montana, North Dakota, South Dakota, Utah, Wyoming	EPA One Denver Place - Suite 1300 999 18th Street Denver, CO 80202-2413 (303) 293-1676

Region IX	Arizona, California, Hawaii, Nevada, American Samoa, Guam	EPA 215 Fremont St. San Francisco, CA 94105 (415) 974-8026
Region X	Alaska, Idaho, Oregon, Washington	EPA 1200 Sixth Ave. Seattle, WA 98101 (206) 442-1099

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GLOSSARY

Administrative order: An official, legally enforceable order issued by EPA to force a facility's owner or operator to address potential threats to human health and the environment resulting from activities at the facility. Administrative orders can be used to force a facility to comply with specific regulations, to take corrective action, and to perform monitoring testing, and analysis.

Administrative record: All information gathered regarding an EPA action, including public comments. EPA makes decisions based on the information contained in the administrative record.

afterburner: The secondary combustion chamber of a rotary kiln incinerator.

air pollution control devices: Mechanisms or equipment which "clean" emissions generated by an incinerator. These devices remove pollutants (particulate matter, acid gases) that would otherwise be released to the atmosphere.

automatic waste feed shut-off system: A device that automatically stops the feeding of waste to an incinerator when it is not operating according to conditions specified in the facility's permit. These operating conditions (for example, temperature, carbon monoxide levels, waste-feed levels) are constantly monitored for deviations from the allowable ranges specified in the permit.

baghouse filtration: An air pollution control method in which emissions containing tiny particles (particulate matter) are passed through a filter. The filter is specifically designed to capture and prevent release of particulate matter to the atmosphere.

Best Demonstrated Available Technology (BDAT): As identified by EPA, the most effective commercially available means of treating specific types of hazardous wastes. The BDAT for a particular waste may change in the futur as new advances in treatment technologies are made.

biological treatment: The use of microorganisms (for example, bacteria) to consume and break down organic wastes. Liquids containing organic wastes are often mixed with oxygen, promoting both the growth of the microorganisms and their consumption of organic materials.

chemical treatment: A broad category of hazardous waste treatment processes that use chemicals to remove dissolved inorganics or transform waste components to less toxic forms.

Code of Federal Regulations (CFR): A series of documents that contain all regulations developed and finalized by government agencies. RCRA regulations are contained in Volume 40 of the Code of Federal Regulations.

combustion: The controlled burning of wastes. During combustion, heat is used to chemically alter the organic compounds in the waste. Combustion converts most of the organic compounds into stable inorganic compounds, such as carbon dioxide and water.

combustion chamber: The actual compartment (chamber) where wastes are burned (combusted) in an incinerator.

delisting: A process whereby a type of waste that is listed as hazardous by EPA can be excluded from hazardous waste regulation. If the generator can demonstrate that a particular waste does not pose risks to human health and the environment, the waste can be delisted.

destruction and removal efficiency (DRE): A percentage that represents the number of molecules of a compound removed or destroyed in an incinerator relative to the number of molecules of the compound which entered the incinerator system. A DRE of 99.99 percent means that 9,999 molecules of a compound are destroyed for every 10,000 molecules that enter the incinerator. A DRE of 99.99 is referred to as "four nines."

dibenzofurans: A group of highly toxic organic compounds for which RCRA regulations set more stringent destruction and removal efficiencies (99.9999, or "six nines") than the DRE required for most other organic compounds (99.99, or "four nines")

dioxins: A group of highly toxic organic compounds that are often found in herbicides. RCRA regulations require a higher destruction and removal efficiency (99.9999) for dioxins than the DRE required for most other organic compounds (99.99).

draft permit: A preliminary permit drafted and published by EPA. The draft permit is subject to public review and comment before EPA takes final action on a permit application.

electrostatic precipitators: Air pollution control devices that use electrical charges to remove particulate matter from emission gases. The process is similar to picking up metal filings or needles with a magnet.

enforcement: Action that may be taken by EPA to ensure that an owner or operator of a hazardous waste management facility is complying with operating conditions specified in the facility's RCRA permit. EPA's compliance monitoring and enforcement program includes inspections of facilities and penalties against violators.

Environmental Impact Statement (EIS): A detailed report on the possible effects that a pending structure or development will have on the environment. An EIS must be prepared by a government agency when a "major" federal action that will have "significant" environmental impacts is planned.

fact sheet: A document prepared by EPA to inform the public about the permitting process and EPA's tentative decision with regard to a permit application.

Federal Register: A document published daily by the federal government containing notification of government agency actions. The Federal Register contains notification of EPA actions, including notification of EPA decisions concerning permit applications.

financial assurance for closure: Documentation or proof that an owner or operator of a facility is capable of paying the projected costs of closing his or her facility. RCRA regulations require a hazardous waste management facility owner or operator to provide financial assurance in the form of a trust fund, letter of credit, or similar financial mechanism.

flash point: The lowest temperature at which the vapors above a volatile substance ignite in air when exposed to flame.

fluidized bed incinerators: A type of incinerator which uses a bed of hot sand or other granular material to transfer heat directly to waste, resulting in waste destruction. Currently, these incinerators are used mainly for municipal sludge.

fugitive emissions: Releases of vaporized pollutants to the atmosphere that occur at all sites at which hazardous waste is managed. Fugitive emissions can occur when vapors are vented from containers or tanks where hazardous wastes are stored. Fugitive emissions can also be caused by spills occurring during the unloading of hazardous wastes from vehicles that transport the waste, leaks through pipes and valves, and through operation of faulty equipment.

hazardous wastes: Wastes exhibiting any of the following characteristics: ignitability, corrosivity, reactivity, or EP-toxicity (yielding toxic constituents in a leaching test). In addition, EPA has listed as hazardous other wastes which do not necessarily exhibit these characteristics. Although the legal definition of hazardous waste is complex, the term more generally refers to any waste that EPA believes could pose a threat to human health and the environment if managed improperly. RCRA regulations set strict controls on the management of hazardous waste.

HSWA: Hazardous and Solid Waste Amendments of 1984. These amendments to RCRA greatly expanded the scope of hazardous waste regulation. In HSWA, Congress directed EPA to take measures to further reduce the risks to human health and the environment caused by hazardous wastes.

inert: Lacking the ability to chemically react with other substances.

inorganic compounds: Compounds that either do not contain carbon or do not contain hydrogen along with carbon. Inorganic compounds include metals, salts, and various carbon oxides (carbon monoxide, carbon dioxide). These compounds do not combust in incinerators, although incinerators may generate inorganic compounds.

interim status: A legal classification which applies to hazardous waste incinerators or other hazardous waste management facilities that were under construction or in operation by November 19, 1980, and can meet other interim status requirements. Interim status facilities may operate without a permit until EPA has made a final decision on the permit application. EPA is required to approve or deny incinerator permit applications for

public notice: Notification by EPA informing the public of Agency actions, for example, the issuance of a draft permit. For draft permits, EPA must follow procedures to ensure proper public notice, including publication of the notice in newspapers and broadcast of the notice over radio stations.

pyrolysis: A method of thermal treatment that first uses high temperatures in an oxygen-free chamber to transform inorganics into more easily handled forms, and then uses a high temperature oxygen-containing chamber for combustion of organics.

quench chamber: A common type of gas-cooling device in which heated gases are mixed directly with water.

RCRA: Resource Conservation and Recovery Act of 1976. An amendment to the first federal solid waste legislation, the Solid Waste Disposal Act of 1965. In RCRA, Congress established initial directives and guidelines for EPA to regulate hazardous wastes.

response to comments: A document that addresses all significant public comments received by EPA during the public comment period. The document includes a summary of each comment as well as EPA's response to each comment.

risk assessment: The use of established methods to measure the risks posed by an activity such as hazardous waste incineration. Risk assessments evaluate the relationship between exposure to toxic substances and the subsequent occurrence of health effects.

rotary kiln incinerator: A type of incinerator that includes a rotating combustion chamber. The constant rotation of the combustion chamber keeps waste moving, allowing the wastes to vaporize (convert to gas) for easier burning.

secondary combustion chamber: The compartment or chamber immediately following the primary combustion chamber. Organic compounds partially combusted in the primary chamber are further combusted in the secondary combustion chamber.

sludge: A thick, heavy, mud-like mixture of solids and liquids often resulting from the settling of solids from a liquid.

slurry: A thin, watery mixture of solids and liquids. Slurries contain more water than sludges and, as a result, slurries flow more easily.

spray tower scrubber: A device that uses alkaline water to neutralize hydrogen chloride gas. The alkaline water is injected in a spray of tiny droplets into a chamber where the acid gas is also introduced. The small size of the droplets aids in the neutralization of the gas.

supercritical water: A type of thermal treatment that uses moderate temperatures (>374°C) and high pressures to enhance the ability of water to break down large organic molecules into smaller, less toxic ones. Oxygen injected during this process combines with the simple organic compounds to form carbon dioxide and water.

Superfund: The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), passed in 1980. A federal statute that gives the federal government the ability to respond to hazardous waste releases that pose a potential threat to human health and the environment. CERCLA established a fund (also known as "Superfund") which finances the responses taken by the government.

thermal treatment: The use of elevated temperatures to treat hazardous wastes. Thermal treatment changes the chemical and/or physical composition of a waste. Types of thermal treatment include incineration and pyrolysis.

trial burn: A test for incinerators in which wastes are fed into the incinerator and emissions are monitored for the presence of specific organic compounds (POHCs), particulates, and hydrogen chloride.

TSCA: Toxic Substances Control Act. The federal statute under which the incineration of PCBs is regulated.

venturi scrubbers: Air pollution control devices that use water to remove particulate matter from emissions.

waste feed: The flow of wastes into an incinerator. Waste feeds can vary from continuous flows to intermittent (batch) flows.

waste minimization: Measures or techniques that reduce the amount of wastes generated during industrial production processes.

100-year floodplain: The land area in the vicinity of a body of water that is expected to be flooded once every 100 years. Determinations about the location of a floodplain are made based on land areas affected by previous floods and the frequency with which various size floods occur.