Abstract

The growth of urban communities requires attention to the problem of solid waste disposal. The planning of facilities for incineration of the waste is the responsibility of the architect or engineer, while the manufacturer of the incinerator must supply equipment to meet the requirements. As an aid to this planning the Incinerator Institute of America sets forth eight points to be considered. These points cover questions of location, layout, air supply and draft, features of environment, and attention to local codes and ordinances. Reference is made to types of waste and some of the problems in handling and burning such waste.

Introduction

Waste disposal is an important part of our every day living. Every community, all industry, every hospital, school and home has or has had a waste disposal problem. The rural community, or the home, school, hospital and industry in the less densely populated areas has the waste but its immediate disposal is not necessarily critical. However, as that same rural community increases in population and as surrounding communities increase in size and their borders join the borders of other communities, the waste disposal problem becomes critical. No areas are left for land fill operations, open burning must cease, industry must stop stream pollution and the waste disposal problems become critical.

The growing community must plan its municipal incinerator well in advance of this critical point. Industry and institutions, whether municipal or privately owned, must plan their own waste disposal facilities, at least for those wastes which must or are best destroyed at the source.

It is the architects' or engineers' responsibility to provide the proper overall planning; to locate the incinerator at the most convenient point to facilitate material handling; to provide adequate space around the incinerator; to provide an adequate air supply to the incinerator; and to provide adequate draft producing equipment if a completely satisfactory installation is to be made.

It is the incinerator designer's or manufacturer's responsibility to provide an incinerator of proper design to destroy the wastes as they accumulate or as they are collected, yet not create another problem—that of air pollution.

However, it must be remembered that the incinerator designer cannot be held responsible and no attempt should be made to hold him responsible for the overall planning, the portion over which he has no control. Everyone will agree that the best designed incinerator will not operate nuisance free if, in the overall planning, adequate operating space has not been provided, sufficient combustion air is not supplied to the incinerator room or if the stack or chimney is inadequate.

The members of the Incinerator Institute of America realize the need for early and adequate planning and have brought this to the attention of the designing
architect and engineer in the 1960 and again in the 1963 "Incinerator Standards". The chapter entitled, "Essentials for Good Planning" merely states the eight points which should be taken into consideration in the overall planning of the waste disposal facilities. These points bear repeating here, together with the reasons why they are so important.

1) Collection and Method of Charging the Refuse

The architect and/or engineer must in the initial planning of a building or group of buildings, locate the incinerator or incinerators within or outside the building structure to avoid difficulties in bringing the waste material to the incinerator. Generally speaking an all purpose incinerator should be centrally located to keep to a minimum the labor costs of bringing the refuse from the various originating sources to the incinerator site. Similarly an incinerator designed for one particular waste should be located as close as possible to the source of the waste.

The municipal incinerator plant should be located to reduce hauling costs to a minimum. Most municipal budgets show a greater annual cost for collection than for incineration, and collection costs can be kept to a minimum by proper early planning. Long hauls for the collection trucks; long hauls for the ash trucks; traffic through congested areas; and concentration of refuse collection trucks through one street or area should be avoided.

The larger community should seriously consider the installation of more than one incinerator plant to avoid the long hauls and traffic concentrations. Although such planning may result in high original costs of construction, it will result in keeping to a minimum the annual budget expenditures and avoid the costs of extra truck maintenance, road repairs, and loss of time for men and collection equipment.

2) Ample Areas Around the Incinerator for Charging, Stoking, and Ash Handling, As Well As General Maintenance

The architect and/or engineer must in the initial planning provide an incinerator room or area of ample size so that all operations necessary to accomplish good incineration can be carried on. Not only must space be provided for charging, stoking, and ash handling, but also for the maintenance of the incinerator itself, its burners, dampers, etc.

For the industrial and institutional incinerator, the method or methods to be employed for bringing the waste to the incinerator area, and for removal of ash from the area must be taken into consideration in the overall planning. Ample areas should be provided for the storage of carts and cans as well as storage of the refuse itself.

For the municipal plant the traffic problem immediately adjacent to the incinerator plant and at the plant site must be studied to provide ample area for unloading the collection trucks to avoid delays and loss of time. It must be remembered that most municipal collection trucks start out on their respective routes at about the same time and, therefore, arrive at the incinerator plant for unloading at about the same time.

3) Adequate Air Supply to the Incinerator Room at the Storing and Charging Levels

Most smoke abatement authorities recognize the necessity for adequate air supply to the incinerator and their regulations require fixed louvers to supply such air to the incinerator room. If the charging of the incinerator is accomplished from a room adjacent to the incinerator room or from a room above the incinerator room, air supply must be provided to both rooms. As an example, if 3000 cfm is required to operate the incinerator, this quantity of air should be available at all times in both the incinerator room and charging room.

It is preferable to have more air available than actually required for combustion purposes, than to have short of air and it is absolutely essential that the air supply at the incinerator be at atmospheric pressure or a slight constant positive pressure.

4) The Effect Which Any Air Conditioning Equipment, or Ventilating Fans May Have on Air Supply or Draft Available From Draft Producing Equipment

It is important that the designing architect and/or engineer in the early stages of design, study the effect of any air conditioning equipment, ventilating fans or high speed elevators on the air supply to the incinerator. It must be remembered that a negative air pressure in a corridor or in a room immediately adjacent to the incinerator room may rob the incinerator of its air supply whenever the incinerator room door to such a corridor or room is open.

Lack of combustion air is the prime reason for incomplete combustion with its resultant smoke and odor. The air in any building which is equipped with an air conditioning system or a ventilating system must be kept in complete balance at all times, at least in that portion of the building which encloses the incinerator. The air intake fans must supply not only the air which will exhaust through the exhaust fans, but all air used by other equipment within the building.

In any building containing a flue fed incinerator, the air balance in the various corridors is most impo-
tant. A negative or minus pressure in any corridor or hallway which contains a hopper or feed door of a flue fed incinerator will affect the operation of the incinerator and more important will draw combustion gases through the hopper door into the corridor and into the ventilating system.

The effect of the modern high speed elevator on the air supply should be studied carefully. The fast moving elevator acts as a piston creating a positive pressure above it and a negative pressure directly below it. As a result, the air in the corridor adjoining the elevator shaft may at one moment be under a positive pressure and then quickly reverse to a minus pressure as the elevator passes by the corridor.

5) Adequate Draft (Negative Pressure) to Assure Safe Operation and Complete Combustion at Reasonable Temperatures

It is not only important for combustion air to be available at the incinerator, but also that the draft producing equipment be adequate to draw the required combustion air through the various chambers of the incinerator and through the breeching, auxiliary equipment and the stack or chimney itself.

Forced draft fans can only be used to overcome the resistance created by the incinerator grates and the fuel bed. In most industrial and institutional incinerators, the fuel bed thickness and its density varies so widely that forced draft fans serve very little purpose and their usage create operational problems. In municipal incinerator installations forced draft fans are generally used since the waste is reasonably uniform and a fuel bed of uniform thickness can be maintained.

Natural draft chimneys or stacks are the most desirable from an operating and maintenance standpoint. The natural draft chimney functions along with the incinerator increasing in efficiency as the temperature increases.

Induced draft fans on the other hand, decrease in efficiency as the temperature of the gases increases, and therefore, when sized properly to handle hot gases, produce a greater negative pressure than necessary or desirable when handling the cooler gases. Draft regulation, therefore, becomes more critical requiring more precise manual or automatic draft control. In addition the induced draft fan must be kept in operation whenever there is any material burning in the incinerator.

6) The Location of the Top of the Chimney or Stack to Ventilation Intakes, and Penthouses or Other Obstructions

The top of any stack or chimney serving an incinerator or for that matter, any equipment in which combustion takes place, should not be located immediately adjacent to building air intakes. It is naturally not a good practice to place the top of the chimney on a location which permits hot combustion gases to be taken into the air supply system. Not only are the combustion gases at a temperature not desirable in an air supply system, but the gases contain very little, if any, oxygen.

The stack or chimney must be terminated away from or above any penthouses or other obstructions so the natural action of the chimney is not affected by the obstructions, wind direction, or changing atmospheric conditions.

7) The Immediate Environments to Determine the Advisability of the Use of Auxiliary Equipment Such as Fly Ash Collectors or Washers, Pyrometers, Secondary Burners, Draft Gauges, or Smoke Density Indicators, Etc.

The average incinerator is fed a fuel which is not uniform in moisture or Btu content. As the fuel varies so must the air supply and auxiliary fuel be varied by the operator for good incineration. If the installation permits the operator to occasionally view the emission from the stack, he can quickly determine whether he is obtaining good incineration or whether he should adjust air supply, the damper, or make use of the auxiliary fuel. On the other hand, if the operator cannot readily see the top of stack to observe the emissions, he should be provided with instruments such as a pyrometer, draft gauge, or smoke density indicator.

The immediate environment and local smoke abatement regulations must be taken into consideration to determine the advisability or necessity of installing fly ash collectors, gas washers or scrubbers. A properly designed incinerator can be operated keeping the stack emissions within most code requirements. However, the modern hospital, school and some industrial installations are built in the midst of residential areas as well as being surrounded by their own lawns, gardens and spacious parking lots where visible fly ash would be objectionable. Similarly where it is anticipated that toxic or radioactive materials are to be incinerated, additional equipment such as fly ash collectors, gas washers or scrubbers may be required.

8) Current Local Codes and Ordinances

The architect and/or engineer must assure himself that the incinerator he has specified meets the local codes and ordinances. He should not attempt to copy incinerator specifications from a previous job without first making sure that such specifications are updated to meet all local, county and state regulations.
This is very important since it could at some future date prove embarrassing to all concerned if it is found that the incinerator, designed to meet local, county or state regulations does not fit into the space provided and leave adequate space for operating and maintenance.

As cited previously, these are the eight points mentioned in Incinerator Institute Standards under "Essentials of Good Planning", and are and must remain the responsibility of the architect or engineer. The incinerator designer or manufacturer can, of course, furnish the basic incinerator information and aid the architect or engineer in the overall planning. The members of the Incinerator Institute have pledged themselves to make available to architects, engineers, air pollution control authorities and other governing bodies the consolidated wide incinerator experience of all members, and the improvement of present designs and the development of new designs.

Those of us in the incinerator field who are members of IIA feel that the very existence of the organization has brought the general thinking of our engineers to a common meeting ground which cannot help but prove beneficial, not only to us but to the architect, engineer, purchaser and ultimate user of incinerator equipment.

Important to the incinerator design engineer is the Btu value of the waste, its general characteristics, the density as well as ash and moisture content. The Incinerator Standards has, as a matter of convenience, classified wastes and mixtures of wastes into six specific types. Similarly the Incinerator Standards has classified the incinerators into seven specific types or classes. A description of each waste or mixture of waste is outlined and a description of the Classes of incinerators is presented.

However, it must be pointed out that sometimes wastes or mixtures of wastes do not fall into the six general categories and special attention must be given to density of the material and Btu values. As an example Type 1 Waste as described consists of paper, cartons, rags, weed scraps, sawdust, foliage and floor sweepings, having a 25 per cent moisture content, 10 per cent incombustible solids and a heating value of 6500 Btu per pound as fired. Although this is a mixture common to many industrial plants the predominance of paper will reduce the incombustible solids and change the Btu value and similarly the admixture of rubber or plastics will reduce the moisture and the ash content and raise the Btu value considerably. If the incinerator is to be used to destroy large percentages of confidential packaged papers, this should be known to the incinerator design engineer, since the incineration of such packaged materials, or for that matter, any very dense or tightly packed material, presents problems not common to the incineration of loose paper, cartons, etc.

Some such materials require considerably more manual stoking during incineration, or the use of mechanical stokers within the incinerator to assure complete combustion of all wastes placed in the incinerator. The question of mechanical grates should, however, not be oversimplified. It is possible to reduce labor by the introduction of mechanical equipment, but it is seldom possible to eliminate it entirely. It is also true that the hourly rate of pay for the labor increases because the operator of the equipment is now expected to operate and maintain mechanical equipment. In the overall planning, therefore, consideration must be given to initial cost, a capital expenditure, versus a yearly budget item of labor.

In late years much emphasis has been placed on air pollution, and rightly so. However, under Essentials of Good Planning, one cannot lose sight of wastes which create or will create stream pollution. These wastes are primarily liquid and semi-liquid wastes defined as Type 5 Waste in the Incinerator Standards.

Air borne nuisances should not be the only consideration taken into account. For many years all types of industries have disposed of all types of liquid wastes either by allowing them to merely seep into the ground or have piped them to an adjacent creek or river. The resulting water pollution has not only created dangers to the populace of any town or urban areas located downstream, but has so depleted all manner of wild life that the practice can no longer be tolerated. In some areas the very ground water is so polluted with chemical wastes that it must be of concern to all since water is important to all living things as the air itself.

This is an area where the competent designing incinerator engineer can be of great service to all. Any organic chemical waste either liquid, semi-liquid or gaseous, can be piped to a properly designed incinerator where it can be incinerated successfully. Many problems must be taken into account in such a design; problems created by the physical character of the waste as well as those created by the chemical makeup of the waste. The material handling is vitally important and is often a greater problem than the actual burning of the material. Semi-liquids such as tars, sludges, paints, etc. may have to be preheated or mixed to make them pumpable, but the important point to consider here is that incineration offers a solution to a problem that otherwise can effect not only immediate plant personnel but the surrounding areas and all populations that might be located nearby.

At this point it might be well to outline briefly the information that is necessary in order for the incinerator engineer to analyze a specific problem and work up a design for the disposal of organic liquid or semi-
liquid waste. In addition to an accurate estimate as to the hourly capacity in gallons or pounds per hour, the following test information should be provided: Ash content; water content; sediment content (with maximum particle size); flash, fire and pour points; viscosity; Btu content; and specific gravity.

In the design of the incinerator itself, many factors must be taken into account. In industry more than elsewhere, the character of the waste materials, their heat value, density, moisture content, etc., must be analyzed before any definite recommendation is reached. The owner or ultimate user of the equipment should, wherever possible, give to the incinerator designer all information regarding the waste to be destroyed since the designer must tailor his design to the particular problem at hand.

As mentioned at the outset, "waste disposal is an important part of our every day living" and only through proper planning and close co-operation between all parties concerned and early and thorough planning, can the complete and satisfactory solution to any specific incinerator problem be found.