SECTION 11 – INCINERATORS

INCINERATION

by Harry Friedberg – Central Chapter

INCINERATION

The dictionary definition of "incineration" is sufficiently broad to cover all types of burning of rubbish, including cremation, which results in the reduction of the materials to an ash. This definition presupposes that such burning is for the purpose of converting a potentially dangerous nuisance into an innocuous ash of lesser volume. The definition, as far as it goes, is correct, but omits much more than it reveals. The truly important products of incineration are certainly not mentioned and are the ones with which the engineer is concerned.

These are:
- Combustion products
- Volatilized products
- Gas borne particulate matter
- Aerosols

Mechanically, incineration takes place in a chamber connected to a venting system leading to the atmosphere. Therein lies the rub. All products of incineration, exclusive of ash and unburnables, are delivered to the atmosphere and add to the present day air pollution problem. The mechanical parts of an incinerator are simple in concept and design. The parts in the main are a combustion chamber, a grate and associated ash receptacle, an ignition device, a particulate settling chamber, an after-burner, if used, and a venting system. As a result of modern day trend, the ignition and operative energy producing device controls have reached and are moving in the direction of an unwarranted and unnecessary complexity.

Certain factors in the design and manufacture, as well as the understanding and operation of incinerators, have of necessity, been determined empirically. These factors, because of an almost overwhelming volume of variables, do not readily lend themselves to formulation. A few of these determinations follow:

Combustion chamber temperatures, depending upon the type of wastes and methods of ignition and incineration, reach temperatures, varying from 1200 F to 2500 F. When the lower temperatures in this range prevail, the incineration results in the volitilization of some fatty substances which subsequently are deposited on the cooler portions of the venting system, and in incomplete combustion of the load being incinerated. As is to be expected, this lower temperature incineration results in the formation of excess CO and aldehydes. Both are highly objectionable and contribute to air polution and odor. Designers have countered the above by the introduction of more and more excess oxygen (air) to improve combustion and to dilute venting system products. This has lowered the CO content but has lowered the flue gas temperatures. The excess air has resulted in a greater quantity and velocity of the gases vented, resulting in a more complete deposition of volatiles in the venting system, accompanied by a greater quantity of particulate matter delivered to the atmosphere. In the atmosphere, the increased particulate matter is visually noticed as smoke, drawing adverse attention to the process. Quantitatively, the particulate matter has been a "mole hill" in relation to other pollution factors but has been elevated to "mountain" proportions by opportunists who have used this situation for their political advancement.

An example of the low temperature type incinerator is the early domestic incinerator which reduced the incinerator load to a solid fuel by drying out or dehydrating the load and subsequently raising its temperature until ignition took place. There is much to be said in favor of this type of incineration. Cost of operation was negligible, no modern complicated controls were required and its initial cost was low. Although outlawed by many local codes, they were still giving good service after ten or more years of operation.

Dehydration, prior to incineration, has many advantages. The load supplies a major portion of the energy required to maintain combustion, the chemical reaction can be anticipated with accuracy, both qualitatively and quantitatively. It is obvious that waste material containing vegetable and animal matter are subject to putrefaction with the attendant health hazard. Dehydration effectively stops such putrefying reactions. Whoever heard of dried apples or peaches, on the housewife's shelves, rotting.

Incineration of such products, dehydrated or not, produces odors, noxious gases, and particulate matter, which are discharged into the atmosphere. Early efforts to control the situation in respect to air pollution, were started by requiring that incinerators discharge particulate matter of extremely small physical dimensions only. Larger pieces (over 15 microns) discharged from a stack were deemed to be very undesirable. As a matter of fact, the contrary was true. Large particles (over 15 microns) produced a very minor problem. They settled to the ground in a very few minutes and were confined to an area of only a short distance in extent. Air pollution officials and testing laboratories sampled the discharge and complained bitterly if the particles had a ponderable percentage whose largest dimension exceeded 15 microns. They assiduously examined the samples with counting microscopes and seemed superbly happy if the particles were small enough to approach the optical limits of resolution of their respective instruments. They blithely ignored the fact that particulate matter of such small dimensions readily passed through the nasal filtering system, entered the respiratory system and were on their way ready and able to produce fibrosis. Not to mention their contribution to lung cancer. Much of microscopically fine material formed permanent suspensions in the carrying gases. It should be remembered that such aerosols in sufficient quantity, have been shown to have caused fatalities. The foregoing was called to the attention of those concerned many times. It is unfortunate that the interested testing authorities, either deliberately or inadvertently, overlooked the fact that the total incinerator atmospheric pollution was and is only an infinitesimal part of the total air pollution attributable to industry, hydrocarbon processing, road dust, rubber tire particles and the greatest of all, internal combustion engine effluvia.

The foregoing admirably set the stage making incineration (particularly domestic) an ideal political scapegoat. Constant pressure on incineration, and the attendant publicity, directed public attention from the real culprits to the "mole-hill" incinerator. Note the situation in cities such as Detroit and Pittsburgh who did not care to step on the toes of the automobile, steel, refining and other industries. The situation has eased but slightly at this writing.

All of this resulted in requirements and limitations placed directly on the producers of incinerators. The cry was for "smokeless and odorless" units. How little smoke is truly smokeless and how little and what kind of odor is odorless? Probably no one honestly knows. Any statement regarding some is always followed by connotations.

Much money, time and effort has been spent on the problem. Can these objectives be reached? Certainly not, if the results are to be honest, and still keep the price within the means of the middle class purchaser of appliances. Civic participation certainly has not resulted in the lowering of waste and garbage collection costs expected.

To accomplish a *diminution* of smoke, odor and particulate matter delivered to the atmosphere by incinerators requires attention to the following factors.

1. A high fuel input for the primary reduction of the load.
2. The combination of combustion products, excess air, and a fuel flame of an after burner in an after burner.
3. The mixture to be physically scrubbed against surfaces whose temperature exceeds 1200 F.
4. A change of flow direction of the mixture in 2 to lower its kinetic energy to permit the trapping of particulate matter in a settling chamber.
5. Conservation of the energy of combustion and after burning by adequate insulation or the like.

Much progress has been made in the determination of odor. It has long been apparent that odor and aldehydes follow parallel courses in intensity. A.G.A. research on incineration has demonstrated that Carbon monoxide, aldehydes and odor intensities follow parallel courses making it possible to get an indirect reading of odor intensity by determining the CO content of the flue gases. Although admittably imperfect, it is the best approach to date. The publications of A.G.A. on incineration, including the pamphlet on requirements are the only worthwhile material for both the designer and the manufacturer. The required answers are there.

Incinerators will not become a ponderable factor in the appliance field until the industry, code writing authorities and the public realize that a mountain has been made of a mole hill and that the total contribution of incineration to air pollution is truly minor. The writer believes that the time is not far off.