Incineration and the Air Pollution Problem

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There are probably no more controversial subjects today than air pollution and incineration. After more than 100 years of relatively successful operation and general acceptance as a volume reduction process, incineration has now become unacceptable to many environmentally-conscious individuals. In these days of discontent with "the establishment," the new environmentalist has tended to blame the incineration process for all of the ills of solid waste management. There are examples of poor incinerator design and operation which can be used to prove this premise. Unfortunately, these evaluations are not tempered by the experience and background of low-budget, short-handed plant operation brought about by the "sweep it under the rug" or "out of sight, out of mind" philosophy of the recent past. Neither has evaluation of the total environmental effect of incineration, or the lack of it, been considered in this quickness to criticize. Consequently, the immediate source nuisance associated with obsolete plants has frequently been extended to include the total incineration process.

Most sanitary engineers recognize a pattern of evolution in disposal methods as areas are developed. In sparsely populated areas, open dumping was (and still is) practiced extensively. As population densities increased, open dumping gave way to the engineered sanitary landfill which provides an inexpensive disposal method while protecting the public health. When land close to the area of waste generation becomes too costly or nonexistent, sanitary landfilling is frequently continued at remote locations with the refuse being transported in large capacity transfer vehicles. When the cost for transporting to remote sites becomes excessive, the next step is processing for volume reduction prior to landfilling. To date, the only proven volume reduction process is incineration.

With the enactment of the Solid Waste Disposal Act of 1965 and its associated funds for research and demonstration, considerable publicity was given the problem of solid wastes and the estimated cost for its solution. Consequently, untried and unproven concepts for solid waste disposal began to be offered directly to the administrative staff without benefit of technical staff review. The increase in cost for incineration over landfilling was a source of concern for these administrators and anyone offering even a remote possibility of financial relief found a receptive audience. As a result of this direct non-engineering sales approach, many misconceptions were spread about the incineration process. Statements such as "Our process will cost less than incineration"; "Incineration costs more than $20 per ton"; "Our plan will not cause air pollution like incineration" have all added to the mistaken concept that incineration is no longer an acceptable process for use in solid waste management.

Probably the most damaging of the negative sales statements is the one concerning air pollution. Fear of the incinerator stack effluent is very real in the minds of all segments of the population. Public

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meetings and hearings associated with site selection have frequently provided the forum for project opponents whose irresponsible statements scared their fellow citizens into opposing the facility. Often the misstatements were made by quasi-technical "visitors" in an effort to force acceptance of so-called breakthrough concepts that were in the primitive early stages of development. Almost all proponents of new and untried schemes are looking for public financing of their research and development programs.

It is necessary to review this recent history if the air pollution problem associated with incineration is to be put in proper perspective. The erroneous statements made by the uninformed or the over-zealous proponent of alternate systems must be corrected if we are to achieve any degree of stability in a field which has become almost totally emotional. New systems must be sold on their own merit and not by falsely criticizing proven concepts.

At the 1967 National Conference on Air Pollution held in Washington, D.C., it was estimated that the total air pollution problem could be attributed to producers as follows: [1]

Motor vehicles	60%
Industry	16.2%
Power plants	14%
Space heating	5.6%
Incinerators	4.2%

Further verification of this breakdown came from a Public Health Service study as reported in August of 1968, as follows: [2]

Transportation	60%
Industry	19%
Power generation	12%
Space heating	6%
Refuse burning	3%

While the portion of the total air pollution problem chargeable to refuse burning is relatively small, there is no question that improvements in incinerator technology are required. One way that some regulatory agencies have undertaken to assure that these improvements are forthcoming is through the adoption of rigid air pollution control emission standards. Where these standards have been realistically developed, they provide the incentive for improvement within the framework of new technology based on proven experience and justify the approach. Unfortunately, some regulations have been written so restrictive that the technology does not exist to meet them. Where this has occurred, incineration must be eliminated from the list of disposal methods available for use until the technology catches up or the regulations are changed. There have even been instances where emission standards have been established ridiculously low through political motivation. As a result of this short-sighted approach, some areas of the country are on the verge of having to use untried and unproven systems of disposal.

Within the past ten years, emission standards and test methods have changed considerably. In the past, the American Society of Mechanical Engineers provided the basis for most efforts of air pollution control regulation. The previously used ASME code emission standard of 0.85 pounds of dry dust per 1,000 pounds of flue gas (corrected to 50% excess air) was considered adequate to protect the public health. Incinerator designs just prior to 1965 were developed to limit dry dust loadings to 0.65 pounds per 1,000 pounds of flue gas corrected to 50% excess air. Based on the few plants tested with ASME test procedures, it was shown that the 0.85 pounds was achievable in most incinerators with spray baffles in the flue. It was further developed that 0.65 pounds was about the limit of correction that could be expected from this relatively simple control device. (Under present terminology the 0.85 pounds and 0.65 pounds represent approximately 0.49 grains and 0.37 grains per standard cubic foot, respectively.) Most continuous feed incinerators constructed in this country were designed to operate within this emission range. Some recently constructed plants have been equipped with more sophisticated air pollution control equipment but the confusion on test procedures and terminology has prevented a true evaluation of its effectiveness to date.

Under a November, 1969 date, the National Air Pollution Control Administration, forerunner of the EPA Office of Air Programs, published the Interim Guide of Good Practice for Incineration at Federal Facilities. In this guide the standard for emissions for incinerators of over 200 pounds per hour capacity at federal facilities was set at "0.2 grains of particulate matter per standard cubic foot of dry flue gas corrected to 12% carbon dioxide (without the contribution of carbon dioxide from auxiliary fuel)." The standard for smaller units of 200 pounds per hour capacity and less was set at 0.3 grains. In addition, the guide required that emissions be measured by procedures described in "Specifications for Incinerator Testing at Federal Facilities (PHS publication October 1967) and any amendments or revisions thereof." The same interim guide defined particulate matter as "any material, except

uncombined water, which is suspended in a gas stream as a liquid or solid at standard conditions." Standard conditions were defined as "a gas temperature of 70 degrees Fahrenheit and a gas pressure of 14.7 pounds per square inch, absolute."

For the first time, federal guidance provided a standard for allowable particulate emission with a specific test procedure designed to measure condensable gases as particulate. Even though the guidelines were published for use at federal installations, there was no doubt that the published requirements were considered reasonable for all incineration. While there has been considerable discussion regarding the reliability of the federal test procedure, many of the recent local air pollution control regulations require its use in testing emissions. There was also almost immediate acceptance of the 0.2 grain emission limit by regulatory agencies being hard-pressed by a public demanding clean air. While incinerator designers were still trying to develop systems that would meet the guideline emission requirements the real confusion began.

Although the PHS Bureau of Solid Waste Management, forerunner of the EPA Office of Solid Waste Management Programs, tested several incinerators in this country using the federal test procedure, reports published to date indicate that no plant was operating within the emission requirements set in the guidelines when the condensable fraction of the particulate was included.[3] Even with this information available, the die had been cast and before technology was proven that could achieve the 0.2 grain level, consideration was being given to even more restrictive emission levels. As this paper is written, publication is expected of the advisory committee's recommendations to the EPA Office of Air Programs for new federal requirements. The new requirements are expected to be more stringent than the previously published 0.2 grain which has yet to be achieved using the federal test procedure at a municipal or large-capacity plant. At the same time, various states have adopted regulations well below the previously considered acceptable but so far unachievable 0.2 grains.

While a discussion of this type could continue indefinitely, it serves no useful purpose and consideration of the alternatives is in order. Many incinerator designers have informed their clients that proven technology is not available to allow the design of an incinerator with any assurance that it can meet emission requirements below the 0.2 grain level when it is put in operation. Few administrators are willing to risk the high cost for plants under those conditions and incinerator construction is not being undertaken in many areas. The definite statements that emissions less than the 0.2 grain level are achievable can usually be attributed to regulatory agency personnel who do not have the responsibility for producing the system design, novices who do not fully understand the impact of the particulate definition, or those uninformed on presently available hardware limitations. As long as this situation exists there are not likely to be many incinerators constructed.

EUROPEAN PRACTICE

Considerable publicity has been given to European incineration practices and until very recently, the implication was that they were well ahead of the technical limitations experienced in this country. The European definition of particulate does not yet include condensable gases and their regulations are not as restrictive as those either existing or being proposed in many areas of the United States. The commercially available electrostatic precipitator will achieve the reasonable level of emission control required even under conditions of relatively short furnace gas detention times. This more practical approach to the problem has allowed the use of incineration in a manner that offers net benefits in the overall air pollution problem which should be carefully considered.

The use of refuse fired boilers for steam generation and power production reduces the total pollution experienced if fossil fuel were burned for steam generation and the refuse was burned only to reduce its volume prior to disposal. In at least one West German city, the steam from refuse fired boilers is used for power generation and then routed to a nearby residential complex to provide district heating. This practice further reduces the total pollution potential by also reducing the fossil fuel burned for residential heating. Since refuse is a relatively clean fuel and the majority of its already low sulfur content is trapped in the ash residue from a well designed modern furnace, significant benefits appear to be available.

FUTURE POTENTIAL

There are attempts presently being made to temper the unrealistic regulatory approach with common sense and proper technical and economic fundamentals. When the general public realizes that it must pay the costs for the emotionally and politically oriented environmental games being played, we can expect a change in attitude. Only through the proper

application of engineering fundamentals can we expect the solid waste problems of this nation to be solved. The technology required to solve these problems must be based on a foundation of experience and proven by practice before public dollars can universally be committed to new methods. The problems of today must be solved with the tools available today and not some artist's concept of tomorrow's development. Removing a significant tool such as incineration for emotional reasons or through ignorance without replacing it with a reasonable alternative is unrealistic and can only increase the problem of solid waste disposal in heavily developed areas.

The alternate processes being offered to replace incineration when sanitary landfilling is no longer economically justifiable are not yet proven substitutes that can be used with any degree of assurance that they will provide the required solution. Some of the proposed extensions of incinerator technology such as pyrolysis appear to offer potential but still require more operating experience than laboratory or pilot plant operation can provide. The claims for volume reduction equal to incineration through shredding, baling, or a combination of both are yet to be proven. These proposed practices still offer the uncertainty associated with long-term biological and chemical degradation in a highly compacted landfill. Recycling appeals to the desire to save natural resources and undoubtedly has potential. Recycling has been practiced for a long time within the limits set by our basic economic framework. In 1966, ten million tons of waste paper were recycled and reused in this country. More lead is produced from scrap than from mined ore and nearly half the copper products produced in this country are manufactured from recycled scrap.[4] Even when recycling capabilities have been extended by removing the present legislative barriers, significant quantities of solid waste requiring disposal are still expected. At the rate the per capita solid waste generation is increasing, it is reasonable to expect that further volume reduction will be required before final disposal of the residue from the recylcing process. For the foreseeable future, incineration with heat reclamation and recycling of the valuable fraction of the ash residue is expected to be a reasonable way to satisfy the basic desire for resource recovery.

A new approach to incinerator air pollution control is needed if this future potential is to be achieved. Realistic emission standards must be established with a timetable for improvement which will allow the use of incineration as a waste management tool and still assure that the air pollution control technology will be developed. The relative importance of the total impact from solid waste disposal requires that consideration of air pollution alone be expanded to include the total environmental effect. The real health hazard in solid waste management is doing nothing. The hazards of uncollected waste accumulating in heavily developed communities have been exhibited in the recent past by labor strikes in major metropolitan areas. It would be unconscionable to allow the same thing to occur by being over-zealous in the regulation of a single area of environmental consideration.

SUMMARY

The role of incineration in air pollution is relatively small when considered from the standpoint of the total problem. Overemphasizing this role from a purely emotional standpoint will only serve to delay the development of really viable solutions to the solid waste problem.

When sites for sanitary landfilling become unavailable, the normal evolution of disposal practices requires the consideration of waste processing to achieve volume reduction prior to final disposal. At the present time the only proven volume reduction process is incineration. The elimination of this solid waste management tool in the name of a single narrow environmental consideration is unrealistic and can only lead to further chaos.

Incineration has the potential to provide resource saving through utilization of the refuse heat content and resource recovery through recycling of the valuable components of the ash residue. Even with resource recovery from raw refuse, a large volume of waste will require further volume reduction prior to final disposal. Reasonable emission regulations coupled with a realistic timetable for increasing their stringency are required if the full realization of this potential is to be accompanied by improvements in incinerator design and air pollution control technology.

The role of incineration in solid waste management must be evaluated from the standpoint of its impact on the total environment. If we are to achieve the desired environmental protection and restoration, the present hysteria must give way to common sense and allow proven principles of economics and technology to be applied.

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