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Project Summary

Assessment of Waste Fuel Use in Cement Kilns

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This study was initiated to document current knowledge concerning the use of waste fuels in cement kilns. Technical and economic factors affecting the use of cement kilns to destroy waste materials are reviewed. The recommendations derived from the study propose additional work required to understand thoroughly the impacts of this disposal technique.

Many plants have used wastes of relatively low toxicity to supplement their fuel needs. In addition, researchers in Canada, Sweden, and the United States have successfully demonstrated extremely high destruction efficiencies in cement kilns when burning highly toxic organic wastes. These studies indicate that a significant potential exists for the expanded use of cement kilns to safely dispose of many types of hazardous wastes generated in the United States and Puerto Rico.

The risks incurred in burning toxic wastes in cement kilns appear to be very low. Given proper controls, emissions of organic compounds are likely to be at or below analytical limits of detection. Particulate loadings will increase when halogenated wastes are burned; hence, excess dust capture capacity may be required to utilize this type of waste effectively.

The economics of using waste fuels appears to be quite favorable for both cement plants and waste suppliers. Disposing of hazardous wastes through incineration or landfilling is likely to be more costly to waste generators than utilizing cement kilns. Cement plants using waste fuels could potentially reduce production costs by up to several dollars per ton.

This Project Summary was developed by EPA's Industrial Environmental Research Laboratory, Cincinnati, OH, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Background

The development of sound methods for disposing of hazardous industrial wastes is critical to ensuring the protection of public health and the environment. Although some restrictions and uncertainties exist as to the types and quantities of wastes that can be used as fuels in cement plants, cement kiln disposal is likely to be both environmentally and economically superior to conventional disposal methods such as landfilling and incineration.

A large volume of organic industrial wastes currently being generated in the United States and Puerto Rico could potentially be used as supplemental fuels in commercial cement kilns. Prior research has successfully demonstrated the safe destruction of several waste materials in cement kilns, including chlorinated hydrocarbons and highly toxic and stable wastes such as PCBs. Based on these studies, it appears that the wet-process cement plants located in the U.S. have the potential capacity to dispose of all chlorinated organic liquid wastes generated in this country.

Fuel costs, which can represent up to 65 percent of the direct cost of producing cement clinker, could be substantially reduced through the use of waste fuels. Because of the positive value assigned to wastes used as fuels, the costs to waste generators disposing of wastes in cement kilns are expected to be relatively low. Regulations enacted under Subtitle C of the Resource Conservation and Recovery Act provide additional incentives for waste disposal in cement kilns. Under these regulations, wastes sent directly to a cement plant from the waste generator are exempt from most of the standards applicable to hazardous wastes.

This study has focused on the status of waste fuel use in the cement industry. The technical and environmental aspects of waste fuel use, including a review of previous research and a discussion of the appropriate control technology are presented in this report.

Conclusions

The high cost incurred in disposing of hazardous wastes in an environmentally sound manner has led many industries to reduce waste generation rates through process changes and increased recycling. However, significant quantities of industrial wastes will continue to be generated which require disposal. At present, landfilling and incineration are the only disposal technologies employed on a significant scale in the United States. Cement manufacturing kilns could potentially be employed to dispose of large amounts of organic industrial wastes that would otherwise be incinerated or landfilled. Cement kiln disposal is not only more economical than other disposal techniques, but, when properly controlled, appears to be environmentally superior to conventional disposal.

Because many waste products can be readily used as fuels or processed into supplemental fuels, a waste fuel market is rapidly developing in the U.S. Waste generators typically contract with a disposal firm to remove their unwanted byproducts and wastes. The disposal firm will, if possible, distill the organic wastes, reclaim any valuable components for use as feedstocks, sell that portion of the waste stream that can be used as a fuel, and dispose of residues through landfilling or incineration. Some materials, such as used lubricating oils, may simply be accumulated into large batches and sold directly as fuels. If the waste fuel does not contain significant quantities of toxic metals, halogenated materials, or toxic organics, it can usually be safely and economically substituted for coal, oil or natural gas in most industrial processes. However, the hazardous nature of combustion products from halogenated and highly toxic wastes precludes their use as fuels in most industrial processes, cement manufacture being the notable exception.

Cement kilns provide a suitable environment for the complete destruction and assimilation of even the most stable and toxic wastes. The high temperatures, long residence times and strong turbulence encountered in cement kilns have been shown to destroy waste materials such as PCBs to beyond analytical detection limits. In addition, the highly caustic environment of cement kilns acts as an effective scrubbing system for removing acidic residues, such as hydorchloric acid, that can be formed during the combustion of many wastes. The inability of other industries to use halogenated and highly toxic wastes as fuels combined with the demonstrated destructive capacity of cement kilns implies that a tremendous potential exists for using chlorinated wastes as supplemental kiln fuels.

According to EPA estimates, approximately 650,000 metric tons of chlorinated wastes are produced annually in the U.S., primarily in Texas and Louisiana. Wet-process cement kilns, the type most likely to use chlorinated wastes, are located throughout the U.S. including the Southern states. Based on past research, which indicated that chlorine may be introduced into wet-process cement kilns at rates of up to about 0.6 percent of the clinker production rate, U.S. cement plants have the capacity to dispose of all chlorinated wastes being generated in this country. In addition, large batches of wastes such as PCB-contaminated oils stored at sites around the country could be disposed of in cement kilns.

The economics of waste disposal in cement kilns has not been clearly demonstrated to date. However, because the additional capital expenditures and operating costs at a cement plant using waste fuels on a routine basis are anticipated to be relatively low, cement kiln disposal is expected to be economically attractive to both the cement industry and to waste generators. Older wet-process cement plants, which appear uniquely suited to using chlorinated waste fuels, are further attracted to this technology because it would help to regain some of the competitive edge now enjoyed by generally newer, more efficient, dry-process plants.

Despite the demonstrated safety of using cement kilns to dispose of waste products, some uncertainties still exist concerning the mechanisms of waste destruction within cement kilns. Until these mechanisms are better understood, the applicability of available performance data to other kiln designs and waste types will remain questionable.

The most significant barrier to the expanded use of waste fuels in cement kilns is the difficulty of obtaining the necessary public support for such programs. Public concern over potential health hazards has made state pollution control authorities reluctant to issue even limited-duration trial-burn permits for the use of any waste other than relatively innocuous materials. To overcome those fears and successfully foster the implementation of this technology on a significant scale, it will be necessary to expand the existing information base to the point where kiln performance can be reliably predicted through a detailed understanding of the mechanisms of waste destruction in cement kilns. These goals could be accomplished most effectively through a research/demonstration program conducted by the U.S. Environmental Protection Agency.

Recommendations

The use of waste organic materials as supplemental fuels in cement kilns should be examined by the U.S. Environmental Protection Agency in order to determine if there is a need for regulations covering this activity. Currently, this activity is not covered by EPA regulations.

The necessary research can be accomplished most effectively through Federal sponsorship of research/demonstration projects at selected cement plants. These projects should be structured to gather the information required to fully understand the mechanisms controlling waste destruction in cement kilns and the variables affecting system performance. The projected research needs are discussed in detail in Section 7 of this report.

The pressing need to establish safe, environmentally acceptable disposal methods and sites will certainly be alleviated if this technique proves to be satisfactory.

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The complete report, entitled "Assessment of Waste Fuel Use in Cement Kilns," (Order No. PB 82-236 043; Cost: $10.50, subject to change) will be available only from:
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