Flue Gas Cleaning Wastes Disposal and Utilization

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Foreword

A coal-fired utility or industrial boiler produces large quantities of solid wastes, principally flue gas desulfurization (FGD) wastes, fly ash, and bottom ash (or boiler slag). Together, FGD wastes and coal ash are generally referred to as flue gas cleaning (FGC) wastes.

Modern fossil-fueled boilers employing conventional coal combustion present a broad spectrum of potential environmental problems. In recent years the development of regulatory constraints pertaining to air and water pollution control have required and will continue to require focus on the environmental management of solid wastes and effluents.

The purpose of this study is to assemble, review, evaluate and report data from research and development as well as commercial activities pertaining to the technology for control of pollution from conventional coal-fired combustion sources (utility plants and large industrial boilers). The review and assessment effort involved review of the data and information available on generation of FGC wastes; disposal options including current practice, R&D and field studies; and utilization practice including technical and economic assessment of current practice and R&D studies. Throughout this work, emphasis has been placed upon wastes produced by commercially demonstrated technologies and, where data are available, by technologies in advanced stages of development that are likely to achieve commercialization in the near future. This book, therefore, will be useful for managers and engineering personnel involved in pollution control decisions in this area.

The predominant part of the solid wastes, excluding bottom ash, is generated by the use of air pollution control devices—electrostatic precipitators, baghouses, and scrubbers—to control emissions of sulfur dioxide and fly ash. Although there are other wastes, such as those from water treatment systems, the quantities of these are small compared to the large amounts of SO_2 scrubber waste produced. In many cases, SO_2 and fly ash emissions are separately controlled and represent separate waste streams. In other cases, FGD wastes and fly ash are combined in a single stream, either through admixture of these wastes or through simultaneous collection.

This study, prepared for the U.S. Environmental Protection Agency, focuses principally on coal-fired utility boilers. Coal-fired plants (vis-a-vis oil or gas) generate the maximum range of wastes and present complex management problems. Further, there is universal consensus that coal utilization is going to increase significantly in the years to come.

The material in the book has been prepared from the following reports:

> *Waste and Water Management for Conventional Coal Combustion Assessment Report—1979. Volume III. Generation and Characterization of FGC Wastes, Volume IV. Utilization of FGC Wastes, Volume V. Disposal of FGC Wastes,* prepared by C.J. Santhanam, R.R. Lunt, C.B. Cooper, D.E. Klimschmidt, I. Bodek and W.A. Tucker of Arthur D. Little, Inc., and C.R. Ullrich of the University of Louisville for the U.S. Environmental Protection Agency, Industrial Environmental Research Laboratory, Office of Environmental Engineering and Technology, Research Triangle Park, NC, March 1980 (EPA Reports 600/7-80-012c, -012d and -012e).

The table of contents provides easy access to the information contained in the book and is organized in such a way as to serve as a subject index.

In order to keep the price of this book to a reasonable level, it has been reproduced by photo-offset directly from the original reports and the cost savings passed on to the reader. Due to this method of publishing, certain portions of the reports may be less legible than desired.

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PART II: DISPOSAL

PART III: UTILIZATION

PART I

GENERATION AND CHARACTERIZATION

1.0 Introduction

1.1 Purpose and Content

With increasing coal utilization in industrial and utility boilers, generation of coal ash (fly ash and bottom ash) and flue gas desulfurization (FGD) wastes, which together comprise flue gas cleaning (FGC) wastes, is expected to increase dramatically in the next twenty years. While utilization of FGC wastes is also expected to increase, the anticipated vast increase in generation of FGC wastes indicates that much of the FGC wastes will be discharged for disposal. In any case, these wastes present significant sources of environmental concern and utilization opportunities.

This part provides an overall review and assessment of generation of the gas cleaning (FGC) wastes and of the characterization of the chemical, physical, and engineering properties of FGC wastes. As such, it serves as the basis for the following two parts discussing FGC waste utilization and disposal.

The primary focus of this report is on coal-fired power plants; however, many of the characteristics discussed would also apply to wastes from oil-fired boilers. Coal-fired power plants generate the maximum range of wastes and usually the greatest quantity. Thus, they can serve as the logical focus for assessing environmental and technological problems relating to the disposal and utilization of waste materials.

A coal-fired power plant produces two broad categories of coal-related wastes:

- Coal ash, which includes both fly ash and bottom ash (or boiler slag), and
- Flue gas desulfurization (FGD) wastes from the control of sulfur dioxide emissions.

Together, fly ash and FGD wastes are generally referred to as flue gas cleaning (FGC) wastes. In many cases, fly ash and SO_2 emissions are separately controlled and represent separate waste streams. In other cases, fly ash and FGD wastes are combined in a single stream, either through admixture of these wastes or through simultaneous collection of fly ash and SO_2. This review of FGC waste generation and characteristics includes coal ash, FGD wastes, and their combination both as produced directly from FGC systems as well as wastes processed for disposal.

The review and assessment has involved two separate efforts as described below:

(1) Review of the data and information available as of January 1979 on the generation and chemical, physical, and engineering properties of FGC wastes. The review is based upon published reports and documents as well as contacts with private companies and other organizations engaged in FGC technology development or involved in the design and operation of FGC systems and waste disposal facilities. Much of the information has been drawn from the waste characterization studies and technology development/demonstration programs sponsored by the Environmental Protection Agency (EPA) and the Electric Power Research Institute (EPRI).

(2) Based upon the review of the data and assessment of ongoing work in waste characterization, identification of data and information gaps relating to waste generation and properties and the development of recommendations for potential EPA initiatives to assist in covering these gaps. The principal purpose of this effort is to ensure that, ultimately, adequate data will be available to permit reasonable assessment of the impacts associated with the disposal and/or utilization of FGC wastes.

Throughout this work, emphasis has been placed upon wastes produced by commercially demonstrated technologies and, where data are available, by technologies in advanced stages of development that are likely to achieve commercialization in the United States in the near future. In terms of FGD wastes, consideration is limited to nonrecovery FGD systems with focus on those producing solid wastes (rather than liquid wastes). There are very few recovery systems in operation or under construction in the United States, and these generally produce a small quantity of waste in comparison to nonrecovery systems.

1.2 Report Organization

This report presents:

- An overview of FGC technology (Chapter 2),
- Production trends and disposal/utilization options for FGC wastes (Chapter 3),
- Chemical characteristics of FGC wastes (Chapter 4),
- Physical and engineering characteristics of FGC wastes (Chapter 5), and
- An overview of research needs (Chapter 6).