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Frontmatter

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Fly Ash and Coal Conversion By-Products: Characterization, Utilization and Disposal III

Symposium held December 1-3, 1986, Boston, Massachusetts, U.S.A.

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Contents

PREFACE xiii

ACKNOWLEDGMENTS xv

PART I: ENVIRONMENTAL CONSIDERATIONS

LEACHING BEHAVIOR OF FOSSIL FUEL WASTES: MINERALOGY AND GEOCHEMISTRY OF CALCIUM

LEACHATE COMPOSITION AT AN EXPERIMENTAL TEST CELL OF COAL COMBUSTION FLY ASH
L.L. LaBuz, J.F. Villaume and J.W. Bell 17

COMPARISON OF THE BEHAVIOR OF TRACE ELEMENTS DURING ACID LEACHING OF ASHES FROM SEVERAL COALS
J.S. Watson 27

AN ESCA AND SEM STUDY OF CHANGES IN THE SURFACE COMPOSITION AND MORPHOLOGY OF LOW-CALCIUM COAL FLY ASH AS A FUNCTION OF AQUEOUS LEACHING
M.M. Soroczak, H.C. Eaton and M.E. Tittlebaum 37

PROPERTIES AND ENVIRONMENTAL CONSIDERATIONS RELATED TO AFBC SOLID RESIDUES
E.E. Berry and E.J. Anthony 49

ELECTROCHEMICAL STABILITY OF EMBEDDED STEEL AND TOXIC ELEMENTS IN FLY ASH/CEMENT BEDS
R.I.A. Malek and D.M. Roy 59

STUDIES OF ZINC, CADMIUM AND MERCURY STABILIZATION IN OPC/PFA MIXTURES
C.S. Poon and R. Perry 67

STABILIZATION OF DRILLING FLUID WASTE WITH FLY ASH
G.M. Deeley, L.W. Canter and J.G. Laguros 77

PART II: CHARACTERIZATION

SPECIATION IN SIZE AND DENSITY FRACTIONATED FLY ASH II.
CHARACTERIZATION OF A LOW-CALCIUM, HIGH-IRON FLY ASH
R.T. Hemmings, E.E. Berry, B.J. Cornelius and B.E. Scheetz 81

SEM STUDY OF CHEMICAL VARIATIONS IN WESTERN U.S. FLY ASH
R.J. Stevenson and T.P. Huber 99
CORRELATIONS OF CHEMISTRY AND MINERALOGY OF WESTERN U.S. FLY ASH
G.J. McCarthy, O.E. Manz, D.M. Johansen, S.J. Steinwand and
R.J. Stevenson 109

SOME PHYSICAL, CHEMICAL AND MINERALOGICAL PROPERTIES OF SOME CANADIAN
FLY ASHES
R.C. Joshi and B.K. Marsh 113

THERMAL CHARACTERIZATION OF COAL ASH POWDERS: HEAT CAPACITIES AND
MINIMUM SINTERING TEMPERATURES
R. Ledesma, P. Compo and L.L. Isaac 127

PART III: REACTIONS, MICROSTRUCTURE AND MODELING
HYDRATION REACTIONS IN CEMENT PASTES INCORPORATING FLY ASH AND OTHER
POZZOLANIC MATERIALS
F.P. Glasser, S. Diamond and D.M. Roy 139

LABORATORY MODELING AND XRD CHARACTERIZATION OF THE HYDRATION REACTIONS
OF LIGNITE GASTIFICATION AND COMBUSTION ASH CODISPOSAL WASTE FORMS
P. Kumarathasan and G.J. McCarthy 159

ALUMINUM SULFATE HYDRATION RETARDERS FOR HIGH-CALCIUM FLY ASH USED IN
HIGHWAY CONSTRUCTION
M. Tohidian and J.G. Lagueros 171

SOURCES OF SELF-HARDENING PROPERTIES IN FLY ASHES
R.C. Joshi and D.T. Lam 183

MICROSTRUCTURE OF CEMENT BLENDS INCLUDING FLY ASH, SILICA FUME, SLAG
AND FILLERS
M. Regourd 185

MICROSTRUCTURE AND MICROCHEMISTRY OF SLAG CEMENT PASTES
A.M. Harrisson, N.B. Winter and H.F.W. Taylor 199

PORE STRUCTURE DEVELOPMENT IN PORTLAND CEMENT/FLY ASH BLENDS
D.J. Cook, Huu T. Cao and E.P. Coss 209

RESTRICTED HYDRATION OF MASS-CURED CONCRETE CONTAINING FLY ASH
R.H. Hills and N. Buenfeld 221

EFFECT OF FLY ASH INCORPORATION ON RHEOLOGY OF CEMENT PASTES
M. Rattanussorn, D.M. Roy and R.I.A. Malek 229

THE DIFFUSION OF CHLORIDE IONS IN FLY ASH/CEMENT PASTES AND MORTARS
R.I.A. Malek, D.M. Roy and P.H. Licastro 239

MODELING THE EFFECTS OF FLY ASH CHARACTERISTICS AND MIXTURE PROPORTIONS
ON STRENGTH AND DURABILITY OF CONCRETES
E.L. White, D.M. Roy and P.D. Cady 251

MODELING OF TEMPERATURES IN CEMENTITIOUS MONOLITHS
S. Kaushal, D.M. Roy and P.H. Licastro 265
THE EFFECT OF SIMULATED LARGE POUR CURING CONDITIONS ON THE TEMPERATURE RISE AND STRENGTH GROWTH OF PFA CONTAINING CONCRETE
M.J. Coole and A.M. Harrison

PART IV: UTILIZATION

STATUS OF ASTM AND OTHER NATIONAL STANDARDS FOR THE USE OF FLY ASH POZZOLANS IN CONCRETE
R.M. Majko

CONSISTENCY OF PERFORMANCE OF CONCRETES WITH AND WITHOUT FLY ASH
W.T. Hester

SOME PROPERTIES OF CONTRASTING END-MEMBER HIGH CALCIUM FLY ASHES
S. Diamond and J. Olek

VARIABILITY AND TRENDS IN IOWA FLY ASHES
S. Schlorholtz, K. Bergeson and T. Demirel

MONITORING OF FLUCTUATIONS IN THE PHYSICAL PROPERTIES OF A CLASS C FLY ASH
S. Schlorholtz, K. Bergeson and T. Demirel

RECENT DEVELOPMENTS IN THE UTILIZATION OF WESTERN U.S. COAL CONVERSION ASH
O.E. Manz and D.L. Laudal

EVALUATION OF POTENTIAL USES OF AFBC SOLID WASTES
E.E. Berry and E.J. Anthony

ENHANCED RESOURCE RECOVERY BY BENEFICIATION AND DIRECT ACID LEACHING OF FLY ASH
E.E. Berry, R.T. Hemmings and D.M. Golden

CARBOCHLORINATION OF FLY ASH IN A FUSED SALT SLURRY REACTOR
M.S. Dobbins and G. Burnet

GLOSSARY OF TERMS

AUTHOR INDEX

SUBJECT INDEX
Preface

Vast quantities of inorganic by-products are produced when coal is burned or gasified. In the US, nearly 60 million tons of fly ash are removed from power plant stacks each year and more than 80% of this ash is buried in landfills or stored in holding ponds pending burial. Only 10% has found a commercial market, chiefly in concrete-related uses. Conversion of coal, through gasification and other processes, into other energy sources will lead to additional large quantities of ash in the future. With such vast quantities of ash involved, one needs to be attuned to any environmental consequences of burying ash and to any new possibilities of using this vast resource for industrial or civil engineering applications. Thorough characterization of the ash materials and their reactions provides the scientific basis for safe disposal or effective utilization. It is the purpose of this series to report the materials science and engineering aspects of the characterization, utilization and disposal of coal-derived ash.

Of the papers in this volume, 29 are based on presentations in Symposium N of the 1986 Fall Meeting of the Materials Research Society. This was the Society's fifth symposium on the subject of coal ash. Proceedings of the first, edited by S. Diamond, were published under the title "Effects of Fly Ash Incorporation in Cement and Concrete," and are available from D.M. Roy of Penn State's Materials Research Laboratory. Relevant papers from the second symposium, edited by G.J. McCarthy, appeared in the July 1984 issue of Cement and Concrete Research. Proceedings of the third and fourth symposia appeared as Volumes I and II of this series (Mat. Res. Soc. Symp. Proc. Vols. 43 and 65). There will be a Volume IV based on a sixth MRS symposium of this title to be held at the 1987 Fall Meeting.

Six additional papers in this volume were presented in a joint session with Symposium M, "Microstructure Development During Hydration of Cement." Although concerned principally with microstructure, the cement and concrete materials discussed in these papers incorporated coal ash. These six papers are also published in Microstructural Development During the Hydration of Cement, edited by L. Struble and P. Brown, Materials Research Society Symposium Proceedings Volume 85, 1987.

This volume contains both conventional papers and summaries. The papers were peer-reviewed and handled according to the normal criteria for journal articles and invited review papers. Three of the 35 contributions are short summaries that were "communicated" (in the manner of Cement and Concrete Research and the Materials Research Bulletin) by an editor. These are of two types: summaries of work already published and pointers to that literature, and reports of work in progress that is not yet ready for formal publication or is to be submitted for more extensive publication elsewhere.

D. Rai and coworkers provide a well referenced review of the leaching behavior of electrical utility wastes and deal specifically with the geochemical modeling of calcium as an illustration of the mechanistic approach being employed in their work. To provide data under actual field conditions, fly ash has been placed in "test cells" at a Pennsylvania power plant. L.L. LaBuz et al. describe the design of the experiment and summarize the leachate data obtained over the first year of operation. As part of a study aimed at Al extraction from fly ash, J.S. Watson has done acid leaching tests that also provide insight into the extent and correlation of extractability of various elements in the ash. M.M. Soroczak et al. describe the use of ESCA and SEM to study leached ash. R.I.A. Malek and D.M. Roy report results of a study of electrochemical stability of fly ash-concrete pastes used as beds for pipelines, and provide insights into the redox behavior of several of the important trace elements in that ash. The use of fly ash for stabilization of
other wastes is described by C.S. Poon and R. Perry, and by J.G. Laguros and co-workers.

A coal conversion by-product with quite unique characteristics is produced in the emerging atmospheric fluidized bed combustion (AFBC) technology, in which a limestone bed is included in the combustion system to reduce sulfur oxide emissions. In two papers, E.E. Berry and co-workers summarize the types of AFBC units and discuss chemical and physical characteristics, environmental considerations and potential uses of the by-products.

This volume includes significant advances in understanding of fly ash chemistry and mineralogy derived through the application of modern materials characterization methodology. Results of a comprehensive study of low-calcium, high-iron fly ashes are reported by R.T. Hemmings et al. This paper complements a similar study on a high-calcium ash in Volume 65 of this series. The characteristics and extent of variability of high-calcium fly ash from the western U.S. are the subject of papers by R.J. Stevenson and T.P. Huber, C.J. McCarthy et al., R.C. Joshi and B.K. Marsh, and S. Schlorholtz and co-workers. S. Diamond and J. Olek point out the importance of knowing the mineralogy of the calcium in these ashes in addition to the total amount present. W.T. Hester describes strength variations in concrete incorporating fly ash, and notes that this could be due either to inherent variability in the ashes or in curing of the concrete.

The key to many of the uses of coal ash is its hydration behavior. F.P. Glasser, S. Diamond and D.M. Roy provide an extensive review of current knowledge of the hydration reactions of coal ash and similar by-products when incorporated into cement pastes as blending agents. P. Kumararathasan and G.J. McCarthy, and R.C. Joshi and D.T. Lam, describe experiments on the self-hardening hydration reactions in high-calcium ashes. M. Tohidian and J.G. Laguros report studies of chemical additives designed to retard this property.

One of the principal advantages of incorporating blending agents into concrete is the reduction in degradation of properties resulting from the heat of hydration of the Portland cement. Papers by S. Kaushal et al. and M.J. Coole and H.J. Harrison discuss thermal behavior of hydrating blends of concrete and by-products.

Finally, the reader will note that this volume appears in a uniform typeface. Two-thirds of the papers were submitted on disk and the balance were keyboarded at North Dakota State University. In addition to the editing done during the refereeing process, all papers had additional technical editing by the senior editor. It was the editor's goal that this volume would conform to the highest standards possible in a camera-ready format.
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