# Coal Power Plant Materials And Life Assessment Developments And Applications Woodhead Publishing Series In Energy





## HUDSON MARIELA

*Materials for Coal Gasification Power Plant* Woodhead Publishing
Coal will continue to provide a major portion of energy requirements in the United States for at least the next several decades. It is imperative that accurate information describing the amount, location, and quality of the coal resources and reserves be available to fulfill energy needs. It is also important that the United States extract its coal resources efficiently, safely, and in an environmentally responsible manner. A renewed focus on federal support for coal-related research, coordinated across agencies and with the active participation of the states and industrial sector, is a critical element for each of these requirements. Coal focuses on the research and development needs and priorities in the areas of coal resource and reserve assessments, coal mining and processing, transportation of coal and coal products, and coal utilization.
*Development of a Field Demonstration for Cost-Effective Low-Grade Heat Recovery and Use Technology Designed to Improve Efficiency and Reduce Water Usage Rates for a Coal-Fired Power Plant* Oxford University Press
Coal- and gas-based power plants currently supply the largest proportion of the world’s power generation capacity, and are required to operate to increasingly stringent environmental standards. Higher temperature combustion is therefore being adopted to improve plant efficiency and to maintain net power output given the energy penalty that integration of advanced emissions control systems cause. However, such operating regimes also serve to intensify degradation mechanisms within power plant systems, potentially affecting their reliability and lifespan. Power plant life management and performance improvement critically reviews the fundamental degradation mechanisms that affect conventional power plant systems and components, as well as examining the operation and maintenance approaches and advanced plant rejuvenation and retrofit options that the industry are applying to ensure overall plant performance improvement and life management. Part one initially reviews plant operation issues, including fuel flexibility, condition monitoring and performance assessment. Parts two, three and four focus on coal boiler plant, gas turbine plant, and steam boiler and turbine plant respectively, reviewing environmental degradation mechanisms affecting plant components and their mitigation via advances in materials selection and life management approaches, such as repair, refurbishment and upgrade. Finally, part five reviews issues relevant to the performance management and improvement of advanced heat exchangers and power plant welds. With its distinguished editor and international team of contributors, Power plant life management and performance improvement is an essential reference for power plant operators, industrial engineers and metallurgists, and researchers interested in this important field. Provides an overview of the improvements to plant efficiency in coal- and gas-based power plants Critically reviews the fundamental degradation mechanisms that affect conventional power plant systems and components, noting mitigation routes alongside monitoring and assessment methods Addresses plant operation issues including fuel flexibility, condition monitoring and performance assessment
*Study of Conventional Steam Power Plants Capital and Energy Costs 44,000 and 12,650 KW (gross) for United States Atomic Energy Commission, San*

*Francisco Operations Office, Berkeley, California* Elsevier
The United States and China are the world's top two energy consumers and, as of 2010, the two largest economies. Consequently, they have a decisive role to play in the world's clean energy future. Both countries are also motivated by related goals, namely diversified energy portfolios, job creation, energy security, and pollution reduction, making renewable energy development an important strategy with wide-ranging implications. Given the size of their energy markets, any substantial progress the two countries make in advancing use of renewable energy will provide global benefits, in terms of enhanced technological understanding, reduced costs through expanded deployment, and reduced greenhouse gas (GHG) emissions relative to conventional generation from fossil fuels. Within this context, the U.S. National Academies, in collaboration with the Chinese Academy of Sciences (CAS) and Chinese Academy of Engineering (CAE), reviewed renewable energy development and deployment in the two countries, to highlight prospects for collaboration across the research to deployment chain and to suggest strategies which would promote more rapid and economical attainment of renewable energy goals. Main findings and concerning renewable resource assessments, technology development, environmental impacts, market infrastructure, among others, are presented. Specific recommendations have been limited to those judged to be most likely to accelerate the pace of deployment, increase cost-competitiveness, or shape the future market for renewable energy. The recommendations presented here are also pragmatic and achievable.
**Coal Power Plant Materials and Life Assessment** John Wiley & Sons
The U.S. Department of Energy (DOE) was given a mandate in the 1992 Energy Policy Act (EPACT) to pursue strategies in coal technology that promote a more competitive economy, a cleaner environment, and increased energy security. Coal evaluates DOE's performance and recommends priorities in updating its coal program and responding to EPACT. This volume provides a picture of likely future coal use and associated technology requirements through the year 2040. Based on near-, mid-, and long-term scenarios, the committee presents a framework for DOE to use in identifying R&D strategies and in making detailed assessments of specific programs. Coal offers an overview of coal-related programs and recent budget trends and explores principal issues in future U.S. and foreign coal use. The volume evaluates DOE Fossil Energy R&D programs in such key areas as electric power generation and conversion of coal to clean fuels. Coal will be important to energy policymakers, executives in the power industry and related trade associations, environmental organizations, and researchers.
Ultra-Supercritical Coal Power Plants Elsevier
This book is intended to meet the requirements of the fresh engineers on the field to endow them with indispensable information, technical know-how to work in the power plant industries and its associated plants. The book provides a thorough understanding and the operating principles to solve the elementary and the difficult problems faced by the modern young engineers while working in the industries. This book is written on the basis of ‘hands-on’ experience, sound and in-depth knowledge gained by the authors during their experiences faced while working in this field. The problem generally occurs in the power plants during operation and maintenance. It has been explained in a lucid language.
**Analysis of Flue Gas Scrubber Materials from a Coal-Fired Power Plant by Thermogravimetry** Createspace Independent Pub
Fossil-fuel power plants account for the majority of worldwide power generation. Increasing global energy demands, coupled with issues of ageing and inefficient power plants, have led to new power plant construction programmes. As cheaper fossil fuel resources are exhausted and emissions criteria are tightened, utilities are turning to power plants designed with performance in mind to satisfy requirements for improved capacity, efficiency, and environmental characteristics. Advanced power plant materials, design and technology provides a comprehensive reference on the state of the art of gas-fired and coal-fired power plants, their major components and performance improvement options. Part one critically reviews advanced power plant designs which target both higher efficiency and flexible operation, including reviews of combined cycle technology and materials performance issues. Part two reviews major plant components for improved operation, including advanced membrane technology for both hydrogen (H2) and carbon dioxide (CO2) separation, as well as flue gas handling technologies for improved emissions control of sulphur oxides (SOx), nitrogen oxides (NOx), mercury, ash and particulates. The section concludes with coverage of high-temperature sensors, and monitoring and control technology that are essential to power plant operation and performance optimisation. Part three begins with coverage of low-rank coal upgrading and biomass resource utilisation for improved power plant fuel flexibility. Routes to improve the environmental impact are also reviewed, with chapters detailing the integration of underground coal gasification and the application of carbon dioxide (CO2) capture and storage. Finally, improved generation performance is reviewed with coverage of syngas and hydrogen (H2) production from fossil-fuel feedstocks. With its distinguished international team of contributors, Advanced power plant materials, design and technology is a standard reference for all power plant engineers and operators, as well as to academics and researchers in this field. Provides a comprehensive reference on the state-of-the-art gas-fired and coal-fired power plants, their major components and performance improvement options Examines major plant components for improved operation as well as flue gas handling technologies for improved emissions control Routes to improve environmental impact are discussed with chapters detailing the integration of underground coal gasification
*An Evaluation of Bituminous Coal Refuse and Power Plant Ash for Use as Highway Base Materials* Woodhead Publishing
Coal Power Plant Materials and Life AssessmentElsevier
**An Introduction to Thermal Power Plant Engineering and Operation** Notion Press
This book presents the evolution toward advanced coal-fired power plants. Advanced power plants with an efficiency level of 45% are today commercially available and even more efficient plants are in their development phase. Considering that presently many pulverized coal-fired power plants operate with an efficiency of about 32%, an improvement of more than 40% specific coal consumption and CO2 discharge can be achieved. Before trying to apply as a secondary measure the use of carbon sequestration, it seems that this 40% specific CO2 discharge reduction as a primary measure can much easier be achieved. The effect of power generation on the environment can be drastically improved by the use of flue gas cleanup systems in advanced pulverized coal-fired power plants (SO2 emission reduction from 40 to 1.4 lb/MWh and NOx emission reduction from 7.5 to 0.64 lb/MWh). With an increased number of coal-fired plants, CO2 discharge and emissions can be reduced, even with an increase of electric power generation in the US by 38% over the next 20 years. Even though the book concentrates on pulverized coal-fired power plants, it also discusses and compares other options like fluidized-bed combustion and coal gasification.
**The Power of Renewables** National Academies Press
Coal accounts for approximately one quarter of world energy consumption and of the coal produced worldwide approximately 65% is shipped to electricity producers and 33% to industrial consumers, with most of the remainder going to consumers in the residential and commercial sectors. The total share of total world energy consumption by coal is expected to increase to almost 30% in 2035. This book describes the challenges and steps by which electricity is produced form coal and deals with the challenges for removing the environmental objections to the use of coal in future power plants. New technologies are described that could virtually eliminate the sulfur, nitrogen, and mercury pollutants that are released when coal is burned for electricity generation. In addition, technologies for the capture greenhouse gases emitted from coal-fired power plants are described and the means of preventing such emissions from contributing to global warming concerns. Written by one of the world’s leading energy experts, this volume is a must-have for any engineer, scientist, or student working in this field, providing a valuable reference and guide in a quickly changing field.
*BOILER MATERIALS FOR ULTRASUPERCRITICAL COAL POWER PLANTS.* Elsevier
The principal objective of this project is to develop materials technology for use in ultrasupercritical (USC) plant boilers capable of operating with 760 C (1400 F), 35 MPa (5000 psi) steam. This project has established a government/industry consortium to undertake a five-year effort to evaluate and develop of advanced materials that allow the use of advanced steam cycles in coal-based power plants. These advanced cycles, with steam temperatures up to 760 C, will increase the efficiency of coal-fired boilers from an average of 35% efficiency (current domestic fleet) to 47% (HHV). This efficiency increase will enable coal-fired power plants to generate electricity at competitive rates (irrespective of fuel costs) while reducing CO2 and other fuel-related emissions by as much as 29%. Success in achieving these objectives will support a number of broader goals. First, from a national prospective, the program will identify advanced materials that will make it possible to maintain a cost-competitive, environmentally acceptable coal-based electric generation option. High sulfur coals will specifically benefit in this respect by having these advanced materials evaluated in high-sulfur coal firing conditions and from the significant reductions in waste generation inherent in the increased operational efficiency. Second, from a national prospective, the results of this program will enable domestic boiler manufacturers to successfully compete in world markets for building high-efficiency coal-fired power plants.
**Impacts of Coal-fired Power Plants on Local Ground-water Systems** Coal Power Plant Materials and Life Assessment
Accurate analysis of reagent and reaction products during flue gas sulfur dioxide (SO2) removal by wet-limestone scrubbing provides important information on system efficiency and operating conditions. Major process constituents that must be determined are calcium carbonate (CaCO3), coprecipitate hemihydrate [(CaSO3.CaSO4).1⁄2H2O], and gypsum (CaSO4.2H2O). Analysis procedures using existing equipment and instrumentation proved too lengthy and inaccurate. A microcomputer-controlled thermogravimetric analysis system was chosen to improve the analysis procedure and results. The analysis procedure consists of heating a dry sample at a constant rate to 950°C in the analyzer. Each of the three major constituents is distinctly identified, and interferences are minimal. A standard software program determines the weight loss of each transition, and a stoichiometric weight calculation is performed to determine the amount of each constituent. Thermogravimetry (TG) is also useful in the analysis of limestone (CaCO3). Comparisons of TG results with independent laboratory results show excellent agreement. Sample preparation and analysis times have been reduced to half that needed by other methods.
**Materials for Supercritical Pulverised Coal-fired Power Plant** Elsevier
The U.S. Department of Energy (DOE) and the Ohio Coal Development Office (OCDO) have undertaken a project aimed at identifying, evaluating, and qualifying the materials needed for the construction of the critical components of coal-fired boilers capable of operating at much higher efficiencies than current generation of supercritical plants. This increased efficiency is expected to be achieved principally through the use of advanced ultrasupercritical (A-USC) steam conditions up to 760°C (1400°F) and 35 MPa (5000 psi). A limiting factor to achieving these higher temperatures and pressures for future A-USC plants are the materials of construction. The goal of this project is to assess/develop materials technology to build and operate an A-USC boiler capable of delivering steam with conditions up to 760°C (1400°F)/35 MPa (5000 psi). The project has successfully met this goal through a focused long-term public-private consortium partnership. The project was based on an R & D plan developed by the Electric Power Research Institute (EPRI) and an industry consortium that supplemented the recommendations of several DOE workshops on the subject of advanced materials. In view of the variety of skills and expertise required for the successful completion of the proposed work, a consortium led by the Energy Industries of Ohio (EIO) with cost-sharing participation of all the major domestic boiler manufacturers, ALSTOM Power (Alstom), Babcock and Wilcox Power Generation Group, Inc. (B & W), Foster Wheeler (FW), and Riley Power, Inc. (Riley), technical management by EPRI and research conducted by Oak Ridge National Laboratory (ORNL) has been developed. The project has clearly identified and tested materials that can withstand 760°C (1400°F) steam conditions and can also make a 700°C (1300°F) plant more economically attractive. In this project, the maximum temperature capabilities of these and other available high-temperature alloys have been assessed to provide a basis for materials selection and application under a range of conditions prevailing in the boiler. A major effort involving eight tasks was completed in Phase 1. In a subsequent Phase 2 extension, the earlier defined tasks were extended to finish and enhance the Phase 1 activities. This extension included efforts in improved weld/weldment performance, development of longer-term material property databases, additional field (in-plant) corrosion testing, improved understanding of long-term oxidation kinetics and exfoliation, cyclic operation, and fabrication methods for waterwalls. In addition, preliminary work was undertaken to model an oxyfuel boiler to define local environments expected to occur and to study corrosion behavior of alloys under these conditions. This final technical report provides a comprehensive summary of all the work undertaken by the consortium and the research findings from all eight (8) technical tasks including A-USC boiler design and economics (Task 1), long-term materials properties (Task 2), steam- side oxidation (Task 3), Fireside Corrosion (Task 4), Welding (Task 5), Fabricability (Task 6), Coatings (Task 7), and Design Data and Rules (Task 8).
Coal Van Nostrand Reinhold Company
Coal-based power generation systems provide reliable, low-cost power to the domestic energy sector. These systems consume large amounts of fuel

and water to produce electricity and are the target of pending regulations that may require reductions in water use and improvements in thermal efficiency. While efficiency of coal-based generation has improved over time, coal power plants often do not utilize the low-grade heat contained in the flue gas and require large volumes of water for the steam cycle make-up, environmental controls, and for process cooling and heating. Low-grade heat recovery is particularly challenging for coal-fired applications, due in large part to the condensation of acid as the flue gas cools and the resulting potential corrosion of the heat recovery materials. Such systems have also not been of significant interest as recent investments on coal power plants have primarily been for environmental controls due to more stringent regulations. Also, in many regions, fuel cost is still a pass-through to the consumer, reducing the motivation for efficiency improvements. Therefore, a commercial system combining low-grade heat-recovery technologies and associated end uses to cost effectively improve efficiency and/or reduce water consumption has not yet been widely applied. However, pressures from potential new regulations and from water shortages may drive new interest, particularly in the U.S. In an effort to address this issue, the U.S. Department of Energy (DOE) has sought to identify and promote technologies to achieve this goal.

**Power Plants** National Academies Press

Advances in Ultra-low Emission Control Technologies for Coal-Fired Power Plants discusses the emissions standards of dust, SO2, NOx and mercury pollution, also presenting the key technologies available to control emissions in coal-fired power plants. The practical effects of ultra-low emissions projects included help the reader understand related implications in plants. Emphasis is placed on 300MW subcritical, 600MW subcritical, 660MW supercritical and 1000MW ultra-supercritical coal-fired units. The influence of different pollutant control units, such as wet electrostatic precipitator, desulfurization equipment and the electrostatic precipitator are also analyzed, and the pollutant levels before and after retrofitted ultra-low emissions are compared throughout. Provides a unique analysis of advanced technologies, such as dust-removal, desulfurization and denitrification used for ultra-low emissions in coal-fired power plants Introduces emission standards for dust, SO2, NOx and Mercury pollution from coal-fired power plants in China, the US and Europe Provides solutions to reducing emissions based on technological advances in China Analyzes the environmental and economic effects of these technologies

*Construction Materials for Coal Conversion* Amer Society of Mechanical

Good,No Highlights,No Markup,all pages are intact, Slight Shelfwear,may have the corners slightly dented, may have slight color changes/slightly damaged spine.

*Requirements for Materials R & D for Coal-fuelled Power Plant* National Academies Press

The continued use of coal as a means of generating electricity and an increasing demand for cleaner, more efficient energy production has led to advances in power plant technology. Ultra-supercritical coal power plants reviews the engineering, operation, materials and performance of ultra-supercritical coal power plants. Following a chapter introducing advanced and ultra-supercritical coal power plants, part one goes on to explore the operating environments, materials and engineering of ultra-supercritical coal power plants. Chapters discuss the impacts of steam conditions on plant materials and operation, fuel considerations and burner design, and materials and design for boilers working under supercritical steam conditions. Chapters in part two focus on improving ultra-supercritical coal power plant performance and operability. Ash fouling, deposition and slagging in ultra-supercritical coal power plants are highlighted along with pollution control measures and the estimation, management and extension of the life of ultra-supercritical power plants. Further chapters provide an economic and engineering analysis of a 700°C advanced ultra-supercritical pulverised coal power plant and discuss CO2 capture-ready ultra-supercritical coal power plants. Ultra-supercritical coal power plants is a comprehensive technical reference for power plant operators and engineers, high-temperature materials scientists, professionals in the power industry who require an understanding of ultra-supercritical coal power plants and researchers and academics interested in the field. Provides a comprehensive reference on the developments, materials, design and operation of ultra-supercritical power plant Considers the degradation issues affecting this type of plant, as well as emissions control and CO2 capture technology; improved plant controls critical to improved operation and environmental performance Contains operational assessments for plant safety, plant life management, and plant economics

*Advanced Power Plant Materials, Design and Technology* DIANE Publishing

"Debunks the political rhetoric surrounding the Obama administration's environmental policies; Traces the source of contemporary environmental problems to a tragic flaw in the Clean Air Act of 1970; Provides a thorough but accessible history of air pollution control in the United States."--Publisher's website.

Struggling for Air Elsevier

This is a print on demand edition of a hard to find publication. Analyzes the factors that determine the cost of electricity from new power plants. These factors -- including construction costs, fuel expense, environ. regulations, and financing costs -- can all be affected by government, energy, environmental, and economic policies. Contents: (1) Intro. and Org.; (2) Types of Generating Technologies: Electricity Demand and Power Plant Choice and Operation; Utility Scale Generating Technologies; (3) Factors that Drive Power Plant Costs; (4) Fuel Costs. Appendixes: Power Generation Technology Process Diagrams and Images; Estimates of Power Plant Overnight Costs; Estimates of Technology Costs and Efficiency with Carbon Capture; Financial and Operating Assumptions. Charts and tables.

**Coal**

Due to their continuing role in electricity generation, it is important that coal power plants operate as efficiently and cleanly as possible. Coal Power Plant Materials and Life Assessment reviews the materials used in coal plants, and how they can be assessed and managed to optimize plant operation. Part I considers the structural alloys used in coal plants. Part II then reviews performance modelling and life assessment techniques, explains the inspection and life-management approaches that can be adopted to optimize long term plant operation, and considers the technical and economic issues involved in meeting variable energy demands. Summarizes key research on coal-fired power plant materials, their behavior under operational loads, and approaches to life assessment and defect management Details the range of structural alloys used in coal power plants, and the life assessment techniques applicable to defect-free components under operational loads Reviews the life assessment techniques applicable to components containing defects and the approaches that can be adopted to optimize plant operation and new plant and component design

*Boiler Materials for Ultra Supercritical Coal Power Plants*

Coal power plants generate about half of the United States' electricity and are expected to remain a key energy source. Coal power plants also account for about one-third of the nation's emissions of carbon dioxide (CO2 ), the primary greenhouse gas that experts believe contributes to climate change. Current regulatory efforts and proposed legislation that seek to reduce CO2 emissions could affect coal power plants. Two key technologies show potential for reducing CO2 emissions: (1) carbon capture and storage (CCS), which involves capturing and storing CO2 in geologic formations, and (2) plant efficiency improvements that allow plants to use less coal. The Department of Energy (DOE) plays a key role in accelerating the commercial availability of these technologies and devoted more than $600 million to them in fiscal year 2009. Congress asked GAO to examine (1) the maturity of these technologies; (2) their potential for commercial use, and any challenges to their use; and (3) possible implications of deploying these technologies. To conduct this work, GAO reviewed reports and interviewed stakeholders with expertise in coal technologies. DOE does not systematically assess the maturity of key coal technologies, but GAO found consensus among stakeholders that CCS is less mature than efficiency technologies. Specifically, DOE does not use a standard set of benchmarks or terms to describe the maturity of technologies, limiting its ability to provide key information to Congress, utilities, and other stakeholders. This lack of information limits congressional oversight of DOE's expenditures on these efforts, and it hampers policymakers' efforts to gauge the maturity of these technologies as they consider climate change policies. In the absence of this information from DOE, GAO interviewed stakeholders with expertise in CCS or efficiency technologies to identify their views on the maturity of these technologies. Stakeholders told GAO that while components of CCS have been used commercially in other industries, their application remains at a small scale in coal power plants, with only one fully integrated CCS project operating at a coal plant. Efficiency technologies, on the other hand, are in wider commercial use. Use of both technologies is, however, contingent on overcoming a variety of economic, technical, and legal challenges. In particular, with respect to CCS, stakeholders highlighted the large costs to install and operate current CCS technologies, the fact that large scale demonstration of CCS is needed in coal plants, and the lack of a national carbon policy to reduce CO2 emissions or a legal framework to govern liability for the permanent storage of large amounts of CO2. With respect to efficiency improvements, stakeholders highlighted the high cost to build or upgrade such coal plants, the fact that some upgrades require highly technical materials, and plant operators' concerns that changes to the existing fleet of coal power plants could trigger additional regulatory requirements. CCS technologies offer more potential to reduce CO2 emissions than efficiency improvements alone, and both could raise electricity costs and have other effects. Most stakeholders told GAO that CCS would increase electricity costs, and some reports estimate that current CCS technologies would increase electricity costs by about 30 to 80 percent at plants using these technologies. DOE has also reported that CCS could increase water consumption at power plants. Efficiency improvements offer more potential for near term reductions in CO2 emissions, but they cannot reduce CO2 emissions from a coal plant to the same extent as CCS. GAO recommends that DOE develop a standard set of benchmarks to gauge and report to Congress on the maturity of key technologies. In commenting on a draft of this report, DOE concurred with our recommendation.