Advances in Materials Technology for Fossil Power Plants

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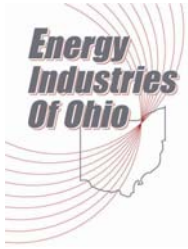

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Preface

Over 180 participants from 16 countries traveled to Santa Fe, New Mexico, to be part of the EPRI Sixth International Conference on Advances in Materials Technology for Fossil Power Plants. The four-day conference featured a combination of invited plenary talks, session keynote papers, and technical presentations covering a wide range of subjects pertaining to the use and development of materials for fossil power plants and provided a unique forum for exchange between scientists, engineers, and utilities. This proceeding builds on the successful previous conferences which have been held every three years since 1995 in the following locations: London (England), San Sebastian (Spain), Swansea (Wales), Hilton Head Island (United States), and Marco Island (United States). ASM and EPRI have partnered to publish the last two proceedings and are now pleased to present this volume. In this proceedings, 80+ papers have been included capturing the current state-of-the technology developments (Section 1), ultrasupercritical (USC) boiler materials (Section 2), oxidation and fireside corrosion (Section 3), USC turbine materials (Section 4), creep and life management (Section 5), 9% chromium alloys (Section 6), advanced coating technologies (Section 7), USC castings (Section 8), advanced stainless steels (Section 9), and weld performance (Section 10).

The genesis of this conference and the reason for its success, even amidst a global recession and reduced energy demand, is the worldwide interest in advanced high-efficiency coal power plants. The abundance of coal and the need to maintain a viable coal option, fuel prices, and most importantly the requirements to reduce emissions and CO_2, provide the impetus for improved plant efficiency. The net thermal efficiency of fossil plants has improved from 33% high-heating value (HHV) in the case of the aging fleet of "subcritical plants" to nearly 42% HHV for supercritical plants operating under steam conditions of 1100°F/3600 psi (593°C/25 MPa). To boost efficiencies above 45% HHV, research and development projects are being carried out in Europe, the United States, and Japan on Ultrasupercritical (USC) powerplants (now emerging around the globe with operation above 1100°F/3600psi) and Advanced Ultrasupercritical (A-USC) power plants that can operate at steam conditions of 1300°F/4000 psi (700°C/28 MPa) and above. In Europe, in-plant demonstrations of prototype A-USC components are under way. In the United States, a five-year effort, aimed at A-USC boiler and steam turbine material qualification, has been completed and follow on work under phase 2 is in progress. Additionally, material advancements are now being made to integrate these A-USC technologies with oxyfuel combustion as an attractive option for carbon sequestration.

The key enabling technology that drives high-efficiency power plants is the development of advanced materials and coatings with a considerable increase over traditional alloys in creep strength and corrosion resistance. Major strides have been made in 9–12% chromium (Cr) ferritic steels containing boron (B), cobalt (Co), tungsten (W), and other elements for both boilers and steam turbines that are capable of operating at temperatures of up to ~1150°F (625°C). To operate beyond this limit, vastly improved austenitic steels and alloys such as HR3C, NF 709, Super 304 H, 347 HFG, HR6W, are being evaluated. For operation above 1300°F (700°C) nickel-based alloys such as Inconel 740, alloy 230, 617, 263, and Haynes 282 are needed. Optimization of component fabrication processes including forming, welding, casting and forging are a critical factor in serviceability of these alloys.

Research on these topics and materials are covered in the Proceedings.

Finally, the conference featured a special Honorary Session for the retirement of Professor Vis Viswanathan (FASM) in which many of his outstanding achievements were described by long time colleagues and friends. This was a remarkable and deserved tribute to one of the commanding figures of his generation in the field of power engineering materials. His contributions to the field cannot be understated.

D. Gandy and J. Shingledecker

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