3-D Woven Ceramic Composite Hot Gas Filter Development

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Abstract

Westinghouse, with Techniweave as a major subcontractor, is conducting a three-phase program aimed at providing advanced candle filters for a 1997 pilot-scale demonstration in one of the two hot-gas filter systems at Southern Company Service's Wilsonville PSD Facility. The Base Program (Phases I and II) goal is to develop and demonstrate the suitability of the Westinghouse/ Techniweave next-generation, composite, candle filter for use in Pressurized Fluidized-Bed Combustion (PFBC) and/or Integrated Gasification Combined-Cycle (IGCC) power generation systems. The Optional Task (Phase III, Task 5) objective is to fabricate, inspect, and ship to Wilsonville 50 advanced candle filters for pilot-scale testing.

Current generation monolithic ceramic filters have experienced catastrophic failure during recent pilot-scale testing. This project plans to develop an advanced filter with damage tolerance, increased durability, increased resistance to crack propagation, and non-catastrophic metal-like failure characteristics through the use of:

- A 3D continuous fiber preform for reinforcement;
- Oxide materials, which are inherently stable in oxidizing environments and have been shown by Westinghouse under DOE Contract No. DE-AC21-88MC25034, Thermal/Chemical Degradation of Ceramic Cross-Flow Filter Materials, to be more resistant to corrosive alkali species than non-oxides, such as SiC and Si_3N_4; and
- Low cost sol-gel processing.

This program's objective is to develop an oxide CMS (ceramic matrix composite) candle filter that is cost competitive with prototype next generation filters. This goal will be achieved through the use of a low-cost sol-gel fabrication process and a 3D fiber architecture optimized for high volume filter manufacturing. During the Base Program, manufacturability for large-scale

filter production will be assessed in order to meet the needs of commercial-scale power generation facilities. The results from this assessment will be implemented during the Optional Task.

To date, Phase I has been completed and these results were reported last year. Phase II experimental activities have been completed in the past year and will be presented at the meeting. High-temperature flow-through corrosion tests up to 400 h and thermal aging tests in static air up to 2,000 h were conducted for Nextel 610- and 720-based filter materials. Methods were developed to fabricate candle-shaped fiber preforms from Nextel 610 and 720 fiber. These preforms were used to make four candle-filter prototype filters, two with Nextel 610 and two with Nextel 720, which were subjected to filter qualification testing in the high temperature, high pressure, filter test rig at Westinghouse STC. Results and conclusions from the above Phase II activities will be discussed.

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