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Continuous Fiber Ceramic Composites (CFCCs) Improve Industrial Gas Turbines

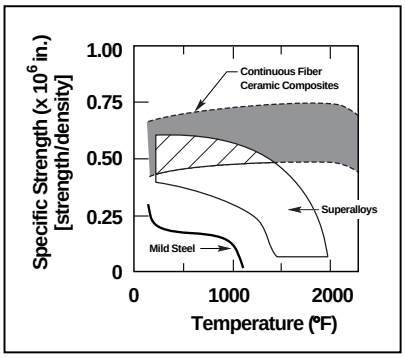
CFCC components, such as combustor liners, shrouds, and interstage seals, are being evaluated for use in industrial gas turbines. These components will allow higher temperature operation in the turbine, increasing the efficiency of the power generation unit, and their use will result in lower emissions. In the Department of Energy CFCC Program, combustor liners supplied by DuPont Lanxide Composites, Inc., Dow Corning Corporation, and McDermott Technology, Inc., are undergoing testing at Solar Turbines, Inc. Tests of several hundreds of hours have been performed on a laboratory scale and have formed the basis for further field tests.

A set of DuPont Lanxide's ceramic composite combustion liner (30 in. diameter) was successfully tested for 950 hours in a Solar Turbines Centaur engine at the ARCO facility in Bakersfield, California, in 1997. Additional testing of 4,000 hours will be completed at Bakersfield in 1998.

At General Electric Corporation, combustor liners are under development, and CFCC shrouds are being evaluated for use in the first stage of an industrial gas turbine. This shroud forms the seal with the rotating blades, minimizing gas leakage. High-temperature, high-pressure rig testing of representative shroud and combustor components will be completed in 1998.

Dow Corning Corporation is developing both a CFCC rim seal and a turbine tip shoe in cooperation with Solar Turbines, Inc., for their Advanced Turbine System engine. If laboratory testing is successfull, scale-up to full-size components will be undertaken late in 1998. Abradability is the key property for achieving success in these two components.

Critical to each of these applications is the strength of CFCCs at elevated temperature. This graph shows the strength advantage that CFCCs have over alloy steels.



BENEFITS:

- More efficient gas turbines will reduce energy consumption and significantly reduce both the NO_X and CO_X emissions in industrial applications.

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In 1992, the Department of Energy initiated a 10-year joint R&D effort between industry, academia, and government to develop advanced ceramic composite materials for industrial applications. Continuous fiber ceramic composites (CFCCs) are lighter, stronger, and more damage tolerant than other materials available for high-temperature use. This cost-shared program will provide significant energy savings for industry and contribute to the economic prosperity of the United States.

CONTINUOUS FIBER CERAMIC COMPOSITE MATERIALS