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Heat-resistant CF8C-Plus meets temperature demands of advanced diesel engines

Advanced diesel engines offer higher fuel efficiency and lower emissions, but they subject their components to extreme temperature fluctuations that exceed 750°F. Commercial cast stainless steels such as CF8C have properties desirable for such applications, but they cannot withstand temperatures above 600–650°C.

CF8C-Plus, a low-cost cast stainless steel alloy developed at ORNL, is an alternative to conventional cast steels that meets the temperature, durability, and reliability requirements of diesel engines, gas turbines, and nuclear reactors. This heat-resistant steel operates in a temperature range from 650 to 900°C. It has creep properties similar to those of nickel-based alloys at the cost of stainless steel. It resists mechanical and thermal fatigue and age-induced failure and is more castable than standard steel, a great advantage for casting either thin- or thick-wall components.

Technology Achievements

- Outstanding high-temperature performance—Microstructural engineering of CF8C-Plus transforms it to an alloy that operates at temperatures of up to 900°C while resisting thermal and mechanical failure and creep failure due to aging.
- Increased stability—Additions of nitrogen and manganese and other adjustments to the CF8C-Plus alloy eliminate delta-ferrite, stabilizing the structure against thermal aging, and enhance creep strength by promoting nanoscale dispersions of niobium carbides and nitrides.
- Castability—Manganese gives CF8C-Plus excellent castability for ease of air-casting components of any size. It requires no heat treatment after casting.

Key Accomplishments

- Trial licenses are in place with companies including General Electric and Stainless Foundry and Engineering, which obtained the first commercial license in 2008.
- Caterpillar's Regeneration System employs CF8C-Plus in more than 35,000 heavy-duty highway diesel engines, saving almost $23 million in manufacturing costs.
- Solar Turbines is using the steel in a 4.5 MW Mercury 50 gas turbine engine at 20 Palms Marine Corps base.
- Honeywell Turbo Technologies is testing the technology for use in diesel and automotive turbochargers.
- Several US companies are testing the alloy for applications other than exhaust systems.
- CF8C-Plus received an R&D 100 award and a Federal Laboratory Consortium award for excellence in technology transfer.

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