Ceramic/Metallic Heat Exchanger Development

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Combine ceramic and metallic heat exchanger cores to produce a low cost, high effectiveness, recuperator for cathode air preheating

Project Objective

Metallic
Advantages
• Manufacturability
• Extended Surface
• Thermal Shock

Disadvantages
• High Cost
• Fouling/Oxidation

Ceramic
Advantages
• Low Cost Materials
• High Temp Stability
• Single Casting

Disadvantages
• Thermal Shock

Hybrid
Advantages
• Low Cost Materials Throughout
• Modular Manufacture
• Temperature Gradients on Ceramic are Reduced
• Thermal Expansion Unrestrained

Ceramic Cores Manufactured by Blasch Precision Ceramics

<table>
<thead>
<tr>
<th>Passage Width (mm)</th>
<th>Heat Transfer Area (cm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core 1</td>
<td>3.3</td>
</tr>
<tr>
<td>Core 2</td>
<td>4.3</td>
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</table>

Ceramic Section Testing

Accomplishments
- Designed, manufactured and tested ceramic heat transfer cores
- Designed, manufactured and tested various metallic heat exchanger cores
- Completed the detailed design of a cross flow ceramic / counter flow metallic hybrid recuperator
- Manufactured and tested prototype 1 kW hybrid recuperators
- Developed heat exchanger models
- Evaluated recuperator designs which are compatible with a "replaceable" cell bundle design
- Developed manufacturing techniques and tested heat exchangers capable of integrated stack cooling and cathode air recuperation

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