Reduction of Green Sand Emissions by a Minimum of 25% - A Case Study

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Vision of the Future
Discussion Points

- Seacoal reduction and/or elimination
  - Improved economics
  - Reduced emission characteristics
CERP Data

- Core/Mold Making Organics: 2%
- Melting Organic: 4%
- Melting Metallics: 3%
- PCS Metallic: 1%
- PCS - 90%

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- Melting Organic: 4%
- Melting Metallics: 3%
- PCS Metallic: 1%
- PCS - 90%
Mold Metal Interface: All bonding materials altered. Clays Calcined, Carbons converted to Ash.

600 F Heat Zone: Sodium Bentonite and Fireclay unaffected. Calcium Bentonite partially calcined, carbons remain.

1200 F Heat Zone: Sodium Bentonite and Fireclay partially calcined. Calcium Bentonite Calcined, Carbons converted to "Fixed Carbons" (coking materials).

Molding sand properties and materials not altered in the remaining prepared sand.
Cross Section of an Iron Mold
Sources of Emissions

- Emissions from core binders and additives
- Emissions from organic moulding sand additives

Diagram:
- Casting
- Molding sand
- Core
Test Apparatus at University of Freiburg
Smoke Comparison

Preblend with Processed Carbon

Traditional ready blend

Both foundries refresh their sand system only for...
Smoke Elimination in Foundry
## CERP Test Results

<table>
<thead>
<tr>
<th>Analyte Name</th>
<th>Reference (5% Seacoal Mix) Average</th>
<th>No Seacoal (with Processed Carbon) Average</th>
<th>Percent Change from Test Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Emission Indicators</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TGOC as Propane</td>
<td>3.3541</td>
<td>0.7720</td>
<td>-77</td>
</tr>
<tr>
<td>HC as Hexane</td>
<td>0.4015</td>
<td>0.1335</td>
<td>-67</td>
</tr>
<tr>
<td>Sum of Target Organic Analytes</td>
<td>0.4271</td>
<td>0.0767</td>
<td>-82</td>
</tr>
<tr>
<td>Sum of Target Organic HAPs</td>
<td>0.3390</td>
<td>0.0642</td>
<td>-81</td>
</tr>
<tr>
<td>Sum of Target POMs</td>
<td>0.0197</td>
<td>0.0014</td>
<td>-93</td>
</tr>
</tbody>
</table>
Foundry LOI Data

LOI (1800°F)

Date

% LOI

Linear (LOI)
Foundry Test Data

1800 F LOI
## Introduction of Seacoal Elimination

<table>
<thead>
<tr>
<th>Sample</th>
<th>Weight of sample</th>
<th>Volume of gases</th>
<th>Emission of gases [mg/kg green sand]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[g]</td>
<td>[dm³/kg]</td>
<td>Benzene</td>
</tr>
<tr>
<td>2008</td>
<td>191.29</td>
<td>20.91</td>
<td>141.15</td>
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<tr>
<td>2008</td>
<td>191.13</td>
<td>20.93</td>
<td>116.15</td>
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<tr>
<td>Average 2008</td>
<td>-</td>
<td>20.92</td>
<td>128.65</td>
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<tr>
<td>2007</td>
<td>189.32</td>
<td>25.35</td>
<td>206.53</td>
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<tr>
<td>2007</td>
<td>191.70</td>
<td>25.04</td>
<td>206.57</td>
</tr>
<tr>
<td>Average 2007</td>
<td>-</td>
<td>25.20</td>
<td>206.55</td>
</tr>
</tbody>
</table>
Reduction in Gas Volume in the Mold

![Graph showing gas evolution rate over time. The graph compares CO-H1 and CO-H2. The gas evolution rate peaks around 10 seconds and then decreases.]

- **Graph Title**: Reduction in Gas Volume in the Mold
- **Y-Axis**: Gas evolution rate (cm³/gs)
- **X-Axis**: Time, s
- **Legend**:
  - CO-H1
  - CO-H2

The graph illustrates the gas evolution rate over time for CO-H1 and CO-H2. The rate peaks around 10 seconds and then decreases.
Coking Characteristic of Seacoal
Expansion Defect

R = Rat Tail
S = Scab

SOURCE: AFS International Atlas of Casting Defects
Examples of Castings
Summary

- Reducing and/or eliminating seacoal will reduce the material cost in green sand. (Economic Advantage)
- Seacoal reduction or elimination will reduce the emission characteristics of green sand. (Environmental Advantage)
- Foundries can make good castings with seacoal reduction or elimination techniques.