Environomics Program for Beneficial Reuse of Metallic Byproducts & SWARF presentation for the

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Solvent Systems International, Inc.

- Privately held, Illinois-based company.
- Providing environmental services and products to industrial customers since 1983.
- SSI Mission Statement:
  - To enhance the competitiveness and environmental performance of our core industries by developing and commercializing reutilization techniques for discarded materials.
  - To provide industry with major new sources of recycled products that meet standardized industrial performance requirements and established environmental regulatory standards.

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Solvent Systems International, Inc.

- Services and products include: environmental services, custom chemical products, parts-cleaning services.
- Transportation & recycling of:
  - Waste oils
  - Waste waters
  - Cutting fluids
  - Solvents
  - Fluorescent bulbs
- Research, development and commercialization of innovative technologies, methods, and processes designed to beneficially recycle and reuse large volumes of industrial waste streams.

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**Solvent Systems International, Inc.**

- **Our Goal:**
  - Reduce Waste:
    - Widen the Base,
    - Sharpen the Tip . . .

- **Major industries served:**
  - Painting and Coating
  - Printing
  - Degreasing
  - Automotive and Industrial Services
Current research is targeting methods to reuse these large volume waste streams:

- Furnace dust/bag house dust
- Metal grinding fines (swarf)
- Fly ash
- Foundry sands
- Slag
- Motor vehicle fluff
Grinding Swarf & Fines

- If charged “as is”, very low recovery.
- Increased environmental costs -- high cost to dispose:
  - Internal handling costs to prepare for disposal are $22.00 to $50.00 per ton.
  - Large consumer of landfill space.
- But ... this waste stream has a high iron content.
- Can we find a way to reuse?
Agglomerated Iron Fines

- Developed an innovative proprietary binding process (patent applied for) that will allow reuse of scrap and iron based waste streams.

  Win ... Win ... Win
  - For foundries: creates a new low cost charge material.
  - For the generators of fines, swarf, and sludge: lowers disposal costs.
  - For the environment: reduces the quantities of material being sent to landfills.
Product Characteristics of Agglomerated Iron Fines

- Chemistry
- Yield
- Strength and Durability
- Melting Characteristics
- Value
## Agglomerated Iron Fines: Chemistry

<table>
<thead>
<tr>
<th>Element</th>
<th>Average</th>
<th>Foundry Request</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon</td>
<td>3.300 %</td>
<td>&gt; 3.0 3.2 desired</td>
</tr>
<tr>
<td>Silicon</td>
<td>2.390 %</td>
<td>&gt; 2.0 2.1 desired</td>
</tr>
<tr>
<td>Phosphorous</td>
<td>0.070 %</td>
<td>&lt; 0.07 0.06 desired</td>
</tr>
<tr>
<td>Sulfur</td>
<td>0.100 %</td>
<td>&lt; 0.100</td>
</tr>
<tr>
<td>Manganese</td>
<td>0.370 %</td>
<td>&lt; 0.8 0.6 desired</td>
</tr>
<tr>
<td>Chromium</td>
<td>0.110 %</td>
<td>&lt; 0.1 0.06 desired</td>
</tr>
<tr>
<td>Nickel</td>
<td>0.043 %</td>
<td></td>
</tr>
<tr>
<td>Copper</td>
<td>0.380 %</td>
<td></td>
</tr>
</tbody>
</table>
Agglomerated Iron Fines

Iron Yield
- Repeated melting tests with Agglomerated Iron gives an average yield of 80%.

Strength and Durability
- After four drops onto concrete from a height of 10 feet, the Agglomerated Iron blocks had less than 7.5% weight loss.
- Less than 5% is typical.
- Wet or Dry!
**Agglomerated Iron Fines**

**Melting Characteristics**
- The SSI proprietary binder coats each particle and binds them together.
- The bonded block will not disintegrate as heat is applied.
- The block begins to soften at approximately 1,800°F to 2,200°F and then melts at the same temperature as gray iron.
Agglomerated Iron Fines

Cupola Melting

Preferred method for melting down Agglomerated Iron.

Advantages:

• All the charges get preheated from the hot blast. No chance of wet or oily scrap coming into contact with molten metal.

• Any oil in the Agglomerated Iron will contribute to the BTU requirements of the cupola.

• Any residual sodium or calcium in the Agglomerated Iron (less than 1%) will melt into the slag, making the slag more fluid, which is a benefit to cupola melters.

• Cupolas are designed to handle a lot of slag. Any increase in slag from Agglomerated Iron will not be a problem.
## Environomics: Foundry Pig Iron

*January 2002 data*

<table>
<thead>
<tr>
<th></th>
<th>Pig Iron</th>
<th>Agglomerated Iron</th>
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</thead>
<tbody>
<tr>
<td>Equivalent Price ($/ton)</td>
<td>$145.00</td>
<td>$118.37</td>
</tr>
<tr>
<td>Iron Yield</td>
<td>98%</td>
<td>80%</td>
</tr>
<tr>
<td>Iron lbs. per gross ton</td>
<td>2,195.2</td>
<td>1,792</td>
</tr>
<tr>
<td>Price per yielded iron($/lb.)</td>
<td>$0.0661</td>
<td>$0.0661</td>
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</tbody>
</table>
Environomics: Mach. Cast
January 2002 data

<table>
<thead>
<tr>
<th>Equivalent Price ($/ton)</th>
<th>Mach. Cast</th>
<th>Agglomerated Iron</th>
</tr>
</thead>
<tbody>
<tr>
<td>$105.00</td>
<td>$93.33</td>
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</table>

<table>
<thead>
<tr>
<th>Iron Yield</th>
<th>Mach. Cast</th>
<th>Agglomerated Iron</th>
</tr>
</thead>
<tbody>
<tr>
<td>90%</td>
<td></td>
<td>80%</td>
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</table>

<table>
<thead>
<tr>
<th>Iron lbs. per gross ton</th>
<th>Mach. Cast</th>
<th>Agglomerated Iron</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,016</td>
<td></td>
<td>1,792</td>
</tr>
</tbody>
</table>

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<thead>
<tr>
<th>Price per yielded iron($/lb.)</th>
<th>Mach. Cast</th>
<th>Agglomerated Iron</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0.0521</td>
<td></td>
<td>$0.0521</td>
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</table>
# Environomics: Clean Auto Cast

January 2002 data

<table>
<thead>
<tr>
<th></th>
<th>Auto Cast</th>
<th>Agglomerated Iron</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Equivalent Price ($/ton)</strong></td>
<td>$120.00</td>
<td>$103.23</td>
</tr>
<tr>
<td><strong>Iron Yield</strong></td>
<td>93%</td>
<td>80%</td>
</tr>
<tr>
<td><strong>Iron lbs. per gross ton</strong></td>
<td>2,083.2</td>
<td>1,792</td>
</tr>
<tr>
<td><strong>Price per yielded iron ($/lb.)</strong></td>
<td>$0.0576</td>
<td>$0.0576</td>
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Agglomerated Iron Fines: Availability

- Targeted Start-up Date is July 2002.
- Approximately 200,000 tons per year.
With your help, we can make lower cost iron through waste utilization.
Discussion & Comments